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THESIS

FUEL INVENTORY MANAGER - DEVELOPMENT OF
SPREADSHEET MODELS FOR EVALUATING AND
FORECASTING INVENTORY POSITIONS AND NET
INVENTORIES OF FUEL FOR NAVY FUEL FARMS

by

Dane A. Denman

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Thesis Advisor: Jane N. Feitler
Associate Advisor: Shu S. Liao

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This thesis addresses the non-standardization of manual Navy fuel farm recordskeeping inventory procedures. It also addresses the errors in calculations and the man-hours required with current procedures. The errors in calculations lead to inventory inaccuracies which increase the possibility of the following: running out of fuel, spills due to overfilling or not being able to detect fuel loss due to leakage in a timely manner. A computerized spreadsheet using Microsoft Excel™ has been developed that will incorporate the formulas and tables used in these calculations in order to eliminate errors. A Users Guide was developed to familiarize the user with the versatility of Microsoft Excel™ to keep track of fuel inventories. This guide provides step-by-step instructions on how to construct the databases and models as discussed in the thesis. In summary, this thesis provides a quick accurate fuel inventory system. This system warrants the possibility of standardization throughout the Navy without an increase in government spending. Also, this system is simple, user-friendly and saves time. By reducing man-hours and labor, it also saves the government money. Information can be downloaded and e-mailed to higher commands as needed for strategic planning and allocation usage.

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Dane A. Denman-Lieutenent, United States Navy
B.S., Texas A&M University, 1984
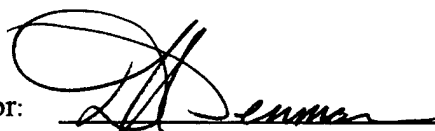
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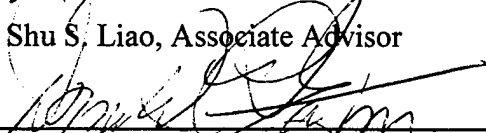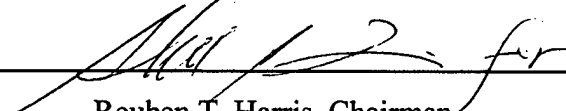### December 1998

Author: _____

Dane A. Denman

Approved by: _____

Jane N. Feitler, Thesis Advisor

_____

Shu S. Liao, Associate Advisor

_____

Donald Eaton, Academic Associate

_____

Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

This thesis addresses the non-standardization of manual Navy fuel farm recordskeeping inventory procedures. It also addresses the errors in calculations and the man-hours required with current procedures. The errors in calculations lead to inventory inaccuracies which increase the possibility of the following: running out of fuel, spills due to overfilling or not being able to detect fuel loss due to leakage in a timely manner. A computerized spreadsheet using Microsoft Excel™ has been developed that will incorporate the formulas and tables used in these calculations in order to eliminate errors. A Users Guide was developed to familiarize the user with the versatility of Microsoft Excel™ to keep track of fuel inventories. This guide provides step-by-step instructions on how to construct the databases and models as discussed in the thesis. In summary, this thesis provides a quick accurate fuel inventory system. This system warrants the possibility of standardization throughout the Navy without an increase in government spending. Also, this system is simple, user-friendly and saves time. By reducing man-hours and labor, it also saves the government money. Information can be downloaded and e-mailed to higher commands as needed for strategic planning and allocation usage.

DISCLAIMER

The reader is cautioned that computer models developed in this research may not have been exercised for all cases of interest. While every effort has been made, within the time available, to ensure that the models are free of computational and logic errors, they cannot be considered validated. Any application of these models without additional verification is at the risk of the user.

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I.   OVERVIEW

A.   INTRODUCTION

This thesis will address the non-standardization of manual Navy fuel farm recordskeeping inventory procedures. It will also address the errors in calculations and the man-hours required with current procedures. The errors in calculations lead to inventory inaccuracies which increase the possibility of the following: running out of fuel, spills due to overfilling or not being able to detect fuel loss due to leakage in a timely manner. A computerized spreadsheet will be developed that will incorporate the formulas and tables used in these calculations in order to eliminate errors.

The Navy manages a worldwide network of over forty fuel farms. The fuel farms must maintain inventories of fuel sufficient to satisfy any customer demands, from Air Force planes, Navy ships, etc., which can be highly variable in both timing and quantity. These global demands for fuel reach over 1.1 billion gallons on an annual basis [C. Tracy, personal communication, August 18, 1998 and Ref. 1: p. 40]. Pipeline, tanker truck, barge, and ship replenish the fuel farms' supplies. Therefore, the farms must have sufficient space available to receive bulk supply shipments while dispensing on an individual per plane basis. The system is made up of the following components, which are all highly interdependent:

- Navy Fuel Farms Capacities
- Customers
- Suppliers
- Transportation Resources

In order for the customer to perform their mission, the fuel farm must have ample supply of fuel on hand. Fuel is ordered from the supplier when the inventory is low. The supplier then transports the fuel to the fuel farm to refill the tanks. However upon delivery, there must be sufficient tank capacity for the supplier to offload all of their product. One way to manage these system interrelationships and interdependencies in sufficient detail to support effective inventory management and storage allocation decision making is through a computerized spreadsheet.

The objective of this project is to develop user friendly mathematical modeling spreadsheets in Microsoft's Excel™ software that will give an accurate daily snapshot of fuel inventory levels, available storage tank capacities, and provide the ability to forecast future fuel inventory ordering needs for Navy fuel farms. This information could then be used to capture and maintain past records, daily, weekly, monthly, and quarterly as well as usage reports that could be generated as needed.

B.   NAVY FUEL FARM

The term "fuel terminal" refers to any of the Navy's various fuel facilities. The standard operations at a Navy fuel terminal include the receipt, storage, and issue of liquid petroleum products. Fuel may be received by ocean-going tanker, barge, pipeline, tank car, or tank truck.

The principal products handled in bulk at Navy fuel installations include any or all of the following:

- naval distillate (F-76)
- jet fuel (JP-5)
- motor gasoline (Mogas)
- several Navy lubricating oils.

On a Navy fuel terminal, a large portion of area is devoted to the tank/fuel farm. The tank/fuel farm area is composed of bulk storage tanks and related facilities, such as pipelines and pumps. There are between five and fifteen fuel storage tanks on a typical Navy fuel farm. Storage tank dimensions differ from one tank to another; hence using individual strapping charts specifically designed for each tank is deemed a necessity. A strapping chart is a table that converts fuel height measurements, better known as tank gaugings, into volume measurements.

C.   FACTORS THAT AFFECT THE VOLUME OF FUEL

Fuel that is used by Navy ships and planes is in a liquid form. Like most liquids, fuel increases its volume when exposed to heat and decreases when exposed to cold. To compute the volume accurately, the following information is required:

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- quantity of product in tank

- quantity of water at the bottom of the tank

- average temperature of the product

- specific gravity of the product

From base to base, the composition of fuel is basically the same, although it's quality and gravity vary with the location the raw material originally came from and the process of refining that raw material.

1. API

Each tank will be filled with fuel that has a certain American Petroleum Institute (API) gravity measurement, which affects the volume of fuel and has to be corrected for. Unless the tanks were completely dry when the fuel farm received fuel, there will be a mixing of different batches of the same type of fuel, which will give different API readings in each tank. Standard procedure at all fuel terminals is to determine the API gravity anytime a new batch of fuel is introduced into a storage tank.

Correction to a standard temperature is necessary because of the expansion and contraction of petroleum at different temperatures. Unless this expansion and contraction are taken into consideration, a tank cannot accurately be said to contain a certain amount of fuel. Volume correction tables are based on the coefficient of expansion of oil. The coefficient of expansion is a direct function of the specific gravity or API gravity. [Ref. 2, p. 6-1] All corrections on fuel will be made at a standard temperature of 60° F, using the most recent edition of the ASTM D 1250/API Tables 5 & 6. These tables are used to convert observed API gravity to API gravity at 60° F. [Ref. 3: p. A-1]

2. Temperature

The volume of liquid petroleum in a container is directly proportional to its temperature; hence, an accurate product temperature measurement must be taken at time of reading [Ref. 4: p. 3-22]. Every tank, depending on its location, will be affected differently by the elements of nature (i.e., wind, sun, etc.). The temperature of the fuel is taken at the same time the tank is gauged. The average temperature of a product is required to calculate its volume at a standard temperature of 60° F. It is important to determine temperatures accurately, because an error in determining the average

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temperature of a product can cause errors of considerable magnitude in calculating the volume of a product at 60° F.

3.   Calculations

It is not difficult to imagine that utilizing data from five to fifteen individual storage tank strapping charts, API charts, manual tank gaugings measurements, and fuel temperature readings, and then entering this information into mathematically complex formulas would present problems in obtaining the correct volume of fuel for each individual tank 100% of the time. Currently at the fuel farms, approximately four out of seven days or 57% of the time, there are errors in the calculations and they must then be recalculated. Researching and troubleshooting the errors results in approximately two to five extra hours each day to complete the task. Most of the errors are due to either misreading the strapping chart or a miscalculation of one of the formulas. [D. Dimick, personal communication, July 22, 1998] If the errors are not caught before a busy day in which a large number of fuel issues were made, it becomes difficult or impossible to figure out what the true gauging of the tank should be.

All three of the sites chosen for this thesis apply some form of the manual methods to compute their daily totals. One site used Excel for minor computations [S. McIntosh, personal communication, August 8, 1998] while another site used a bar code scanner in conjunction with the manual method [J. Lewis, personal communication, August 5, 1998]. There was no uniformity between the sites in the procedures used to determine inventory totals.

Recordskeepers from each of the sites had their own means of calculating the inventory levels. The problem was that everyone who learned the wrong way of records keeping passed that same wrong information on to his or her relief. Mistakes will continue to be made without a standard uniform procedure in place. Another problem encountered with calculations is the loss of corporate knowledge with the turnover of personnel [D. Dimick, personal communication, July 22, 1998]. There were situations where the knowledgeable Recordskeeper was transferred prior to training the new individual assigned to take their place. Generally, it takes several weeks to "turn over" the Recordskeeper position and train the manual methods to the newly assigned individual. If the present Recordskeeper leaves before the newly assigned Recordskeeper

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understands the inventory records keeping procedures, it is possible that it could take up to a few months of correcting daily errors before becoming competent in the manual calculations practice.

D. INVENTORY INACCURACIES

Inventory inaccuracies present both major and minor problems on a fuel farm. Running out of fuel and insufficient storage space are examples of some of the major problems. Fuel loss and variable lead time are examples of some of the minor problems encountered with an erroneous inventory.

1. Running Out

Running out of fuel could lead to problems of a greater scale if that particular fuel farm is supporting a busy Naval Air Station (NAS). Of the three sites, only one site had come close to running out of fuel in the last three years. That site had failed to properly forecast its needs over a weekend. As an example of what could go wrong if fuel were to run out, KC-10 refueler planes would not be able to perform their mission, therefore planes would be unable to re-fuel in air as scheduled, causing operational flights to be delayed, changed, or aborted. Additionally, fighter planes, helicopters, and their pilots also based out of the NAS would be grounded while awaiting fuel. Using data from NAS Sigonella, they refuel an average of thirty-two aircraft per day [D. Dimick, personal communication, July 24, 1998]. For every day the fuel farm is out of fuel, an additional thirty-two aircraft are added to the waiting list to be refueled. These situations impact the fuel farms' "never run out, 100% customer service goal."

2. Storage Space

Another major problem due to an inaccurate inventory is receiving a predetermined amount of fuel and not having enough tank capacity to store it. One of the options to this situation is that the ship would be unable to offload all of the product. This would lead to the government paying demurrage charges while the ship waits to be fully offloaded. The government paid over $1,974,633 in demurrage charges for the military in fiscal year 1997 [Ref. 1: p. 28]. A second option is that the ship offloads all of the product and the tank overflows. This option produces a loss of product and

contamination of a large area, which then has to be cleaned or remediated and heightens the possibility of an explosion.

3. Fuel Loss

Inaccurate inventories may mask the idea that there is a problem with one of the storage tanks leaking fuel. Recognizing the problem early allows some of the product to be recovered before it is contaminated and for repairs to be started on the storage tank. If the problem is not discovered for a long period of time, a large area of soil and even ground water could become contaminated. Contamination cleanup from a leaking storage tank can cost upwards of $100,000 or more [Ref. 5: p. 104]. With today's increasingly stringent pollution standards and environmental regulations, there could also be legal ramifications.

4. Lead Time Variance

Projecting when to order product on a timely basis is also a minor problem due to an inaccurate inventory. Currently, a manager with knowledge of lead time variances, will wait until a certain level of inventory is reached before ordering. The differences in lead time varied greatly with each site. Foreign sites would place their order three months in advance due to the means of transportation and distance involved from supply point to delivery point [S. McIntosh, personal communication, August 18, 1998]. Delivery of product to foreign sites requires crossing the ocean and can only be accomplished by ship. In the continental United States where product is more readily available, orders were placed forty-eight hours in advance of receipt and transportation is usually by pipeline or barge [J. Lewis, personal communication, August 5, 1998]. Variances in product delivery were as high as a one week delay [S. McIntosh, personal communication, August 18, 1998]. If the inventory were incorrectly calculated to be higher than it actually was, the manager ordered later than they normally would have. This process essentially adds days delayed to their lead time.

E. SCOPE AND METHODOLOGY

This thesis compared three Naval Air Stations (NAS Keflavik, Iceland, NAS Sigonella, Italy, and NAS Patuxent River, Maryland) to determine if there were any JP-5 fuel inventory problem commonalities. Information and research regarding problems

from each of the addressed sites were compiled. In addition, figures calculated from all three Naval Air Stations were reported and compared in the thesis. A case study and spreadsheets were developed using data collected from NAS Sigonella. The spreadsheets were specifically designed for use at NAS Sigonella, Italy. A users' guide was also developed and can be customized to assist other facilities that would like to apply this model to their fuel storage tanks.

The thesis will explain the basic equations, notations and procedures used in the creation of the spreadsheets. It also explains some of the specific Microsoft Excel™ procedures and functions used in the creation of the spreadsheets. It is not the intent of this thesis to explain the general use of spreadsheet techniques. This thesis assumes the reader has a basic understanding of personal computer skills and is familiar with the Microsoft Excel™ program.

The Fuels Officer or an individual designated by the Fuel Officer at NAS Keflavik Iceland, NAS Patuxent River Maryland, and NAS Sigonella Italy were interviewed to collect research data and information. Contact was made through electronic mail, phone, and/or personal interviews. Because NAS Sigonella was chosen as the case study, 90% of this thesis will revolve around the data gathered at this site.

Chapter I presented a brief overview of what a fuel terminal is, it's operations and the type of inventory problems it encounters. This thesis will research and address those issues. Chapter II will discuss the building of data tables using Microsoft Excel™. Chapter III will illustrate and explain the formulas used to make volume corrections to fuel. Chapter IV will demonstrate the analytical power and time saving capabilities of the spreadsheets developed. Chapter V will summarize the findings of this thesis. Lastly, a users' guide of the spreadsheet developed will be included as an appendix.

II.   DATA ENTRY

A.   INTRODUCTION

The American Heritage Dictionary defines the word, "database" as a collection of data arranged for ease and speed of retrieval, as by a computer [Ref. 8: p. 366]. This chapter will discuss the different formats of source data and how this tangible data is entered into and structured in Excel™ to produce electronic databases. Four different databases, each with unique setups, will be constructed. The spreadsheet models developed in Chapter III will utilize all four of these databases to standardize or correct the volume of fuel to an ASTM standard of 60° F. This corrected figure for the volume of fuel is reported for actual inventory.

B.   WHY MICROSOFT EXCEL™?

In Excel™, each cell offers several options. These options include the ability to compute numerous equations and functions, along with text editing and formatting capabilities. This computing power takes the form of formulas that can be created in various cells of the spreadsheet. Unlike a paper spreadsheet, which contains only values created somewhere else, Excel™ can store both the formulas and the computed values returned by these formulas. In addition, these formulas are able to utilize values stored in other cells and can automatically update the computed answer returned by a formula anytime that a value is changed.

Excel's™ computational strengths, combined with its formatting and editing capabilities, make the program a versatile tool for generating any kind of document that uses textual and numeric entities and requires calculations to be performed on those values. Because the formulas created in the spreadsheets are dynamic (i.e., calculations automatically updated when reference values stored in other cells of the spreadsheet are changed), it is easier to keep calculated values in a worksheet both current and correct [Ref. 6: p. 17].

The heart of the thesis is the development of several spreadsheets that will minimize the amount of time spent on inventory calculations and corrections, in a format that can be easily understood. The concept is to set up a worksheet that has a minimum

amount of data fields to be entered (i.e., the manual tank gauge, temperature, API) and then allowing Excel™ to figure out the remainder for the user. Microsoft's Excel™ was chosen as the platform because of its numerical versatility and global utilization by the Navy.

A minimal amount of data input will be required in order for Excel™ to retrieve information from the four databases created by the user. The first database will contain the volumetric information from the storage tanks strapping charts, and will be used to figure the gross (i.e., before corrections) volumes of fuel remaining in the tanks. The second database will contain the volumetric information from the fuel trucks strapping charts. This database will be used to figure the gross volumes of fuel remaining in the trucks. The third database will contain a set of volume factors used to correct observed API gravity to API gravity at 60° F. The fourth and final database will contain a set of volume correction factors that are used for converting fuel volumes observed at temperatures other than 60° F to corresponding volumes at 60° F.

C.   BUILDING DATABASES

Entering data into an Excel™ worksheet allows the user the flexibility to change, add to, or move the existing entries without having to re-write or re-type all of the figures. The worksheets are dynamic and permit future information, such as strapping charts, to be added as new tanks are built, or deleted as tanks are condemned and taken out of service. The data typed into these worksheets will be used as an information base, therefore, from this point forward the worksheets that only contain data will be referred to as databases. The purpose of a database is not so much as to calculate new values but rather to store a large amount of information in a consistent manner arranged for ease and speed of retrieval. The databases, will be the foundations that the rest of the spreadsheets will build from and must be precise in entry.

Databases will be constructed from strapping charts for the storage tanks and fuel trucks, Table 5B (Generalized Products Correction of Observed API Gravity to API Gravity at 60° F), and Table 6B (Generalized Products Correction of Volume to 60° F Against API Gravity at 60° F). A file containing the four different databases will be created and kept separate. Keeping this file apart from the other worksheet file will serve

two purposes. First, the data should be separate from the area where the user is entering new data, thus preventing any accidental data changes to the database. Second, due to the sheer magnitude of information from the databases, Excel™ is able to retrieve the data for calculations faster from a separate file rather than from part of a larger file performing both calculations and data storage.

1.   Storage Tank Strapping

A "strapping chart" is a table that converts fuel height measurements into volume measurements. Strapping charts for storage tanks can be arranged with the data beginning at the top of two columns and then descending down to the bottom as shown in Figure 2-1. The left column displays the height of fuel in centimeters (cm) and the right column shows the corresponding volume of fuel in "liters". Example: if the fuel in a storage tank were measured at a height of 5 cm, then the gross (i.e., uncorrected) volume of fuel would be 15,347 liters.

Height in centimeters

TANK "A"	
cm	liters
0	6214
1	8040
2	9867
3	11693
4	13520
5	15347

Volume in liters

Figure 2-1. Example of a Strapping Chart Layout.

Strapping charts for storage tanks can also be arranged with the data shown in a horizontal manner (i.e., rows from left to right) as shown in Figure 2-2. The information in this chart is the same as that in Figure 2-1, presented in a different format.

TANK "A"

Read the table by row, going this direction. ────────→

cm	liter	cm	liter	cm	liter	cm	liter
0	6214	1	8040	2	9867	3	11693
4	13520	5	15347	6	17173	7	19000

Figure 2-2. Example of a Strapping Chart Layout.

To simplify data entry and to enhance Excel's™ ability to retrieve data, the strapping chart database was arranged vertically in two columns. The numbers in the left column ascend, as shown in Figure 2-1. This style was used to create the database for all thirteen fuel storage tanks at NAS Sigonella.

a)   Interpolation Table Given

Some of the larger storage tanks were accompanied with an interpolation table for the millimeters encountered during a tank gauging. An interpolation table determines a set of values between two known values (i.e., if the values for 1 cm and 2 cm are known, then the values for the ten millimeters in between can be found). This interpolation table used four rows with each row divided into millimeter (mm) increments. The row of interpolations used depended on the height of the fuel when gauged. This height scale is displayed as a separate column on the right side of the Table as shown in Figure 2-3. The first row was for fuel with a height of less than 1 meter (i.e., 0 to 99 cm). The second row was for fuel with a height greater than or equal to 1 meter but less than 2 meters (i.e., 100 to 199 cm). The third row was for fuel with a height greater than or equal to 2 meters but less than 3 meters (i.e., 200 to 299 cm). The fourth row was for fuel with a height greater than or equal to 3 meters (i.e., 300 to 399 cm). Example: if the fuel was measured to have a height of 125.4 centimeters, the 125 cm would be found on the strapping chart as was shown in Figure 2-1. But the 0.4 cm is a fraction of a whole centimeter. The interpolation table allows the user to convert a fraction into a "volume". Changing 125 cm into meters gives the user 1.25 meters. Using the Interpolation Table in Figure 2-3, 1.25 meters is greater than 1 meter, but less than 2 meters. This leads the user to use the interpolations found in row 2. Next, the user

will change the 0.4 cm fraction into millimeters, which results in 4 millimeters. Reading the header row from left to right, the user locates the 4 millimeter column. The intersection between row 2 and the 4 millimeter column, reveals the interpolated value of 731 liters. This value is then added to the 125 cm strapping chart value to give the total gross volume. Chapter III will go into more detail on how the spreadsheet models automatically "find" the strapping and interpolation information on the database.

mm 1	mm 2	mm 3	mm 4	mm 5	mm 6	mm 7	mm 8	mm 9	meter
183	365	548	731	913	1096	1279	1461	1644	0
183	365	548	731	913	1096	1279	1461	1644	1
183	365	548	730	913	1096	1278	1461	1643	2
183	365	548	730	912	1096	1278	1461	1643	3

Figure 2-3. Example of an Interpolation Table.

Generally, there was not a great difference, if any, in the four rows. For the sake of simplicity, when setting up the database in Excel™, if two interpolation rows were identical, they were treated as one row with an increased range as shown in Figure 2-4.

Tank "A"	
Interpolation for < 200 cm	
cm	liters
0	0
1	183
2	365
3	548
4	731
5	913
6	1096
7	1279
8	1461
9	1644

Figure 2-4. Example of an Interpolation Table Database Layout in Excel™.

b) ***Interpolation Table not Given***

There were no existing interpolation tables for the smaller storage tanks. For that reason, Excel™ was utilized to accurately calculate the millimeters in between the centimeters. Excel's™ resulting interpolation gave the value for one millimeter, or one tenth of a centimeter for each centimeter in the database. The formula (AK5-AK4)/10 was used to produce the 1.6 liter per millimeter interpolation between 1 and 2 centimeters as shown in Figure 2-5.

	AJ	AK	AL
1	TANK 10		
2	cm	liters	Interpolate
3	0	0	0
4	1	50	1.6
5	2	66	2.1
6	3	87	2.5

Figure 2-5. Example of an Interpolation Table Database Layout in Excel™.

The formulas used to multiply the interpolation by the correct number of millimeters will be discussed in Chapter III.

2.   Fuel Truck Strapping

Fuel trucks are basically mini storage tanks that are mobile. If fuel remains in the fuel truck's tank, it is still considered inventory and must be accounted for. A strapping chart is used to determine this volume of fuel. Trucks come in different model types (i.e., R-9, R-10, etc.). For each type of truck, the manufacturer assigns a strapping chart. There may be 30 trucks in service (i.e., 10 of one model type and 20 of another model type). In this scenario, the user would have two different strapping charts, one for each model. The trucks' strapping charts use non-metric measurements. Volumes are given in "gallons" and measurements or gaugings are given in "inches". Because of the small volume of fuel these trucks hold, there is no interpolation involved for the fractions of inches. When the trucks are gauged, the measurements are rounded to the closest inch.

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This is deemed an acceptable practice due to the small quantity of fuel difference between the inch increments. A spreadsheet model, which will be discussed in Chapter III, requires the data in this database to remain in gallons, therefore no conversion was necessary. With this in mind, a separate database was set up for the trucks with the volumes entered in gallons. A similar style to Figure 2-2 was used to arrange the database for the four different types of fuel trucks.

3. API

There are two different procedures used to produce the volume correction factors contained in Tables 5B and 6B. Table 5B presents the values of API gravity at 60° F corresponding to an API hydrometer reading at observed temperatures other than 60° F [Ref. 7: p. II-2]. The correction factor found in Table 5B is then used to locate the correction factor in Table 6B. Table 6B gives volume correction factors for converting product volumes observed at temperatures other than 60° F to corresponding volumes at 60° F [Ref. 7: p. II-6].

a) Table 5B

Table 5B is two hundred and eighty one pages of solid data as found in Reference 7. At this time, entering all of the data values for all of the temperatures would be too overwhelming a task. A simpler approach would be to find the range of fuel temperatures and the range of observed API's recorded in the last year. Table 5B gives temperatures in half-degree Fahrenheit increments and observed API's in half-degree API increments as shown in Figure 2-6.

	API gravity at observed temperature						
	43.0	**43.5**	**44.0**	**44.5**	**45.0**	**45.5**	**46.0**
Temp		Corresponding API gravity at 60 F					
60.0	43.0	43.5	44.0	44.5	45.0	45.5	46.0
60.5	43.0	43.5	44.0	44.5	45.0	45.5	46.0
61.0	42.9	43.4	43.9	44.4	44.0	45.4	45.9
61.5	42.9	43.4	43.9	44.4	44.0	45.4	45.9

Figure 2-6. Sample of Table 5B.

The layout for this database will be different as compared to that of the storage tanks or the fuel trucks. Once again, a separate database within the same file was set up for Table 5B. Interpolation between the temperatures is not allowed. However, interpolation is allowed between the observed API gravities. To accomplish this, the data was positioned similar to Figure 2-7 displaying four empty columns which were left in between the given values. Each column represents one-fifth the cumulative difference between the top reference API gravity numbers, and is increasing from left to right.

Temp	API gravity at observed temperature					
	43.0					**43.5**
60.0	43.0					43.5
60.5	43.0					43.5
61.0	42.9					43.4
61.5	42.9					43.4

Figure 2-7. Sample of Table 5B Database Layout in Excel™.

The observed API gravity heading was increased by 0.1 for each empty column between the given values. Interpolation calculations were performed for each column using a formula, which took the greater given value for a specific temperature, and subtracted the lesser given value for the same temperature. This difference was then multiplied by one, two, three, four or five fifths depending on relative column position. This product was then added to the lesser given value. It may be easier to understand a quick example using the information found in Figure 2-7. For a temperature of 61.0° F, the greater given API value is 43.4, the lesser is 42.9. The difference between the two values is 0.5. This value is multiplied by $^1/_5$ for the first column and then added back to 42.9 for a result of 43.0. For the next column, the 0.5 difference is multiplied by $^2/_5$ and added back to 42.9 for a result of 43.1, and so on. The users guide in Appendix C furnishes the details on how to complete the Table 5B database.

b)   Table 6B

Table 6B is another large collection of information consisting of two hundred and ninety two pages of solid data as found in Reference 7. Once again, to simplify the task of entering data, a range of fuel temperatures and API factors recorded in the last year will be used to build the database. Table 6B is arranged similar to Table 5B, and gives temperatures in half-degree Fahrenheit increments and API's in half-degree API increments as shown in Figure 2-8.

API gravity at 60 F							
Temp	43.0	43.5	44.0	44.5	45.0	45.5	46.0
	Factor for correcting volume to 60 F						
60.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
60.5	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
61.0	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995
61.5	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992

Figure 2-8. Sample of Table 6B.

A separate database within the same file was set up for Table 6B. At first, the layout of the database will look similar to Table 5B's database. The data was positioned with four empty columns left in between the given values as can be seen in Figure 2-9. At this point the similarities come to a halt.   Interpolation is not allowed between the temperatures or API gravities.

| | API gravity at 60 F | | | | | |
Temp	43.0					43.5
60.0	1.0000					1.0000
60.5	0.9997					0.9997
61.0	0.9995					0.9995
61.5	0.9992					0.9992

Figure 2-9. Sample of Table 6B Database Layout in Excel™.

API gravity can be rounded to the nearest 0.5API increment [Ref. 7: p. II-6]. The Table 6B database can be constructed using the principle that the two columns to the left will be the same as the two columns on the right of the given value column. Notice in Figure 2-10 that the *italicized numbers* are the same as the given value column on the left.

Temp	API gravity at 60 F					
	43.0	43.1	43.2			**43.5**
78.5	0.9907	*0.9907*	*0.9907*			0.9906
79.0	0.9904	*0.9904*	*0.9904*			0.9904
79.5	0.9902	*0.9902*	*0.9902*			0.9901
80.0	0.9989	*0.9989*	*0.9989*			0.9989

Figure 2-10. Example of API Rounding in Table 6B Database in Excel™.

The given API values for column 43.5 will be copied into the two remaining blank columns in the above figure and also copied into the next two columns 43.6 and 43.7 (not shown in figure).

III. MODEL WORKS

A. INTRODUCTION

There are four questions that a Fuel manager must focus on everyday regarding fuel inventory:

How much fuel was received?

How much fuel was issued?

How much fuel is available?

Is there enough fuel?

This chapter will answer these questions with the development of models that have the ability to calculate the correct receipt and issue of fuel. The models will also give accurate accounting information of current fuel levels, a graphical display of those levels, and be able to forecast possible needs in the future. Eight different worksheet models will be in the order in which they should be created. Chapter IV will explain the order and utilization of these models.

B. DAILY MODEL

The first model constructed is the "Daily Model". The significance of this model is to provide an interface between the user and the forthcoming models. The Daily Model is a holding area of uncorrected data waiting to be processed and standardized by the upcoming models. There are no formulas in this model so no calculations are performed. Data (i.e., truck gauges, tank gauges, sample temperatures, water cuts, observed API, tank temperatures, and meter readings) will be entered manually into this model on a daily basis.

The data should be entered in a certain format. All data entered, with the exception of the truck gauge which are entered as whole numbers, should be entered to one decimal place (i.e., 0.2). The formulas used in the upcoming models require the input data to be in the same format as that found in the databases reference data (i.e., values located in the first column of the array). Even though Excel™ has the capability to search the databases for approximates or numbers close to the input data, this is not desired. The accuracy of the upcoming models results depends upon Excel's™ ability to

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find an exact match between the input data from the Daily Model and the reference data from one of the databases.

The layout of the data fields (i.e., cells where data is to be entered) should be grouped by similar fuel and container type to prevent confusion. Figure 3-1 shows a simple layout of two tanks with the same type of fuel.

JP5 FUEL

TANK	GAUGE cm	TEMP Sample	H2O Cut	API Observed	TEMP Tank
A	85	61	0	45.3	68
B	84.6	62	0	45.2	68

Figure 3-1. Example of a "Simple" Layout.

Figure 3-2 is an example of what a Daily Model layout with multiple storage tanks, different models of trucks, and three different types of fuel should look like. Notice that the data fields are shaded. These are the only areas that change daily.

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M10 =

JP5 FUEL

Yesterdays close [450,000] gallons

REFUELER

TANK	GAUGE cm	TEMP Sample	H20 Cut	API Observed	TEMP Tank		TRUCK	GAUGE INCHES
A	85	61	0	45.3	68	Old R-9's	934	46
B	84.6	62	0	45.2	68			
C	198	60	0	46.0	68	New R-9's	125	21
3	70.3	62	3	45.4	68		318	0
4	100	62	0	45.0	70		319	47

GAS STATION

OPENING INVENTORY   CLOSING INVENTORY

GASOLINE Tank	GAUGE cm	TEMP Sample	H20 CUT	API Observed	TEMP Tank	METER	GAUGE cm	TEMP Sample	H20 CUT	API Observed	TEMP Tank	METER
MG1	109	68	0	63.3	64	1379203	180	76	0	62.5	76	1379203
MG2	58	68	4.5	63.2	63	1932816	145.7	76	3	62.4	76	1936453

DIESEL

DFM	225	73	8	40.3	64	1739928	219.8	78	3	40	78	1751956
TNK 10	115.5	68	0	40.5	63	2866607	115.5	78	0	40.4	78	2866607

CHART \ DAILY / ISSUES / JP5CLOSE / JP5WORKS / DEMAND / GAS / Rece

Draw ▼ AutoShapes ▼ ...

Ready   NUM

Figure 3-2. Example of a Daily Model Layout.

C.   ISSUE MODEL

The "Issue Model" is designed for the fuel farm that keeps a manual issue log. This model would not benefit a fuel farm that has automated means (i.e., bar scanner) of keeping track of their issues. However, the issues total from the bar scanner could be entered as a data field in the Daily Model. The purposes of the Issue Model are to keep track of the daily issues by chit number (i.e., issue voucher number) and also to categorize the issues by command or service as is shown in Figure 3-3.

CHIT NUM	A/C TYPE	HC4	LOCL	USN TRAN	USMC TRAN	USA TRAN	USAF TRAN	DEFUEL
185	C-9						2185	
173	P-3		1467					
128	H-53	523						
90	VR-55			3738				
	TOTALS	523	1467	3738	0	0	2185	0

Figure 3-3. Example of an Issue Model Layout.

A brief explanation of the categories is shown in the header row (i.e., top row) of Figure 3-3. CHIT NUM is the chit number. A/C TYPE is the aircraft (A/C) type. HC4 is a locally based helicopter squadron. LOCL is a locally based airplane squadron. USN TRAN is all Navy transient or non-locally based airplane issues. USMC TRAN is all Marine transient or non-locally based airplane issues. USA TRAN is all Army transient or non-locally based airplane issues. USAF TRAN is all Air Force transient or non-locally based airplane issues. DEFUEL is the category for fuel taken off an aircraft. The "defueled" category is treated as a separate category and is neither added nor subtracted from the issue total.

The user can batch post the issues at the end of the day or as a continuous process throughout the day. The chit numbers are entered in the "CHIT NUM" category, followed by the aircraft (A/C) type in the "A/C TYPE" category. The volume of fuel issued is posted under whichever category/service (i.e., Navy, Air Force, etc.) the plane belongs to. Each chit can be entered in a random order (e.g., the information on chit number 5 can be entered after the information on chit number 25 has been entered). If desired, Excel™ can sort these entries by either chit number or aircraft (A/C) type. This feature simplifies the billing procedure at the end of each month. The users guide in Appendix C furnishes the details on how to sort the "Issue" data. All issues are made in gallons. Therefore, all volumes listed in the Issues Model are in gallons. A conversion to liters is not necessary.

The only formula used in this model was the SUM function. This function adds all of the numbers in a range of cells. Example: cells B2:B4 contain the values 100, 55, and 200 as is shown in Figure 3-4. The total amount of issues in the USMC TRAN

category is SUM(B2:B4) which equals 355 gallons. The SUM function was utilized to figure the totals at the bottom of each category and the grand total in the Issue Model. For details on how the Issue Model utilizes the SUM function, see the Users Guide in Appendix C (this function automatically arrives at these totals regardless of the number of issues per day).

	A	B	C
1		USMC TRAN	
2		100	
3		55	
4		200	
5	Total	355	

Figure 3-4.

D. RECEIPT MODEL

The "Receipt Model" represents the receiving report, and is only utilized when receiving a shipment of fuel. A separate Receipt Model will need to be created for each storage tank that can receive product from an outside source. This does not include storage tanks that can only be refilled by receiving transfers from other tanks.

Storage tanks must be gauged before and after receipt of product. The Receipt Model is divided into three areas as is shown in Figure 3-5:

	A	B	C	D	E	F	G	H	I
1	RECEIVING REPORT					TANK: A		DATE:	1-Oct-98
3	JP5								
5	**OPENING INVENTORY**								
6	1. GAUGE READING					235.3			
7	2. GROSS VOLUME OF FLUIDS IN TANK					435,997			
8	3. WATER CUT READING					0.0			
9	4. GROSS WATER VOLUME					0			
10	5. GROSS VOLUME OF FUEL (#2 - #4)					435,997			
11	6. MEASURED API OF SAMPLE					46.4			
12	7. MEASURED TEMPERATURE OF API SAMPLE					67.0			
13	8. API AT 60 F FROM TABLE 5B					45.8			
14	9. TEMPERATURE OF FUEL IN TANK					65.0			
15	10. CORRECTION FACTOR USING TABLE 6B					0.9974			
16	11. NET QUANTITY IN LITERS					434,863			
17	12. NET QUANTITY IN GALLONS					114,879			
19	**CLOSING INVENTORY (After receipt of product)**								
20	13. GAUGE READING					354.0			
21	14. GROSS VOLUME OF FLUIDS IN TANK					652,745			
22	15. WATER CUT READING					0.0			
23	16. GROSS WATER VOLUME					0			
24	17. GROSS VOLUME OF FUEL (#14 - #16)					652,745			
25	18. MEASURED API OF SAMPLE					46.5			
26	19. MEASURED TEMPERATURE OF API SAMPLE					68.0			
27	20. API AT 60 F FROM TABLE 5B					45.8			
28	21. TEMPERATURE OF FUEL IN TANK					67.0			
29	22. CORRECTION FACTOR USING TABLE 6B					0.9964			
30	23. NET QUANTITY IN LITERS					650,395	liters		
31	24. NET QUANTITY IN GALLONS					171,816	gallons		
33	**25. NET QUANTITY RECEIVED (JP5)**					56,937	gallons		
35	**METER CHECK**								
36	26. BEGINNING METER READING					1,000,000			
37	27. ENDING METER READING					1,215,530			
38	28. METER READING DIFFERENCE (liters)					215,530			
39	29. METERED QUANTITY RECEIVED (gallons)					56,937			

RECEIPT / ReceiptB / ReceiptC / MG1 /

Figure 3-5. Receipt Model.

- Opening Inventory - represents the gauging that is performed before the receipt of fuel.

- Closing Inventory - represents the gauging that is performed after the receipt of fuel. See Reference 4 page 3-21 for complete guidance on gaugings, before and after receipt.

- Meter Check - represents the meter readings taken before and after the receipt of fuel.

1. Terminology and Functions

The following terminology and functions are used in the Receipt Model:

a) VLOOKUP

Searches for a value in the leftmost column of a table, and then returns a value in the same row from a column the user specifies in the table. This function is used when the comparison values are located in a column to the left of the data the user wants to find. This function can be entered as part of a formula into the Formula Bar or selected from the Function Box as shown in Figure 3-6.
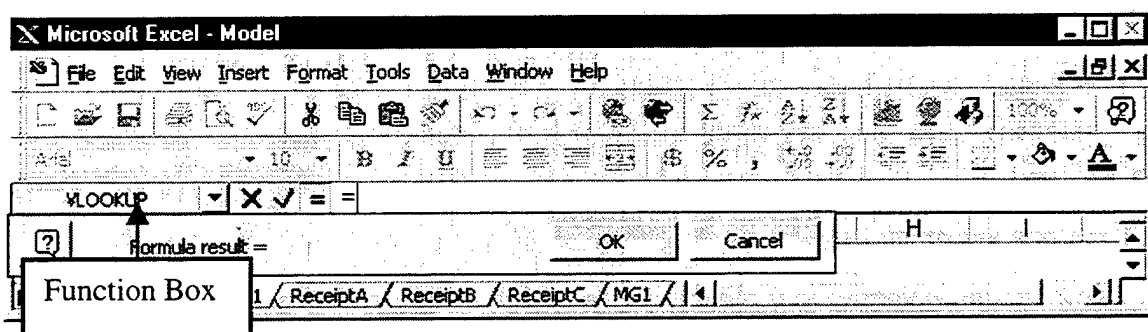

Figure 3-6. A Function Box.

The function looks like:

VLOOKUP(lookup_value,table_array,col_index_num,range_lookup)

- **Lookup_value** - the value to be found in the first column of the array.
- **Table_array** - the table or range of information in which data is looked up. Values must be in ascending order.
- **Col_index_num** - the column number in table_array from which the matching value must be returned. Example: col_index_num of 1 returns the value in the first column in table_array.
- **Range_lookup** - specifies whether the user wants VLOOKUP to find an exact match or an approximate match. If FALSE, VLOOKUP will return an exact match.
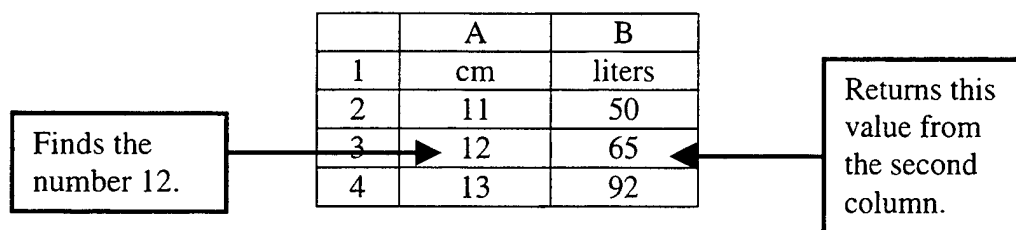
	A	B
1	cm	liters
2	11	50
3	12	65
4	13	92

Finds the number 12. → [points to row 3, value 12]

Returns this value from the second column. ← [points to 65]

Figure 3-7.

Example: VLOOKUP(12, A2:B4,2). This function looks up the height of fuel (12) in the first or leftmost column of the array A2:B4 shown in Figure 3-7. It will return the corresponding gross volume of fuel in "liters" from the second (2) column (i.e., column B), that is located to the right of the height of fuel comparison value found in the first or leftmost column. In this example, the answer is 65 liters.

b) IF

Returns one value if a condition the user specifies is TRUE and another value if FALSE. This function can be entered as part of a formula into the Formula Bar or selected from the Function Box. The function looks like:

IF(logical_test,value_if_true, value_if_false)

- **Logical_test** - any value or expression that can be evaluated to be TRUE or FALSE.
- **Value_if_true** - the value that is returned if logical_test is TRUE.
- **Value_if_false** - the value that is returned if logical_test is FALSE

c) INT

Rounds a number down to the nearest integer. This function can be entered as part of a formula into the Formula Bar or selected from the Function Box. The function looks like:

INT(number)

- **Number** - the real number the user wants to round down to an integer. Example: INT(8.9) equals 8.

d) ROUND

Rounds a number to a specified number of digits. This function can be entered as part of a formula into the Formula Bar or selected from the Function Box.

The function looks like:

ROUND(number,num_digits)

- **Number** - the number the user wants to round.
- **Num_digits** - specifies the number of digits the user wants to round.

e)   MATCH

Returns the relative position of an item in an array that matches a specified value in a specified order. This function is used when the <u>position</u> of the item in a range is needed instead of the item itself. This function can be entered as part of a formula into the Formula Bar or selected from the Function Box.

MATCH(lookup_value, lookup_array,match_type)

- **Lookup_value** - the value the user wants to match in lookup_array.
- **Lookup_array** - a contiguous range of cells containing possible lookup values.
- **Match_type** - if match type is 0, MATCH finds the first value that is exactly equal to lookup_value.

2. Opening Inventory

There are twelve steps in this area of the model. Five of these steps involve manual entries.

Figure 3-8. Example of Opening Inventory on Receipt Model.

The first step is the "Gauge Reading" and is entered manually into the model in cell (F6). This step measures the height of the fuel. The second step is called the "Gross Volume of Fluids in Tank" and uses the following formula to automatically convert the "Gauge Reading" into a gross volume:

VLOOKUP(F6,'C:\AThesis\[TANKS.xls]TANKS'!K3:L388,2)

+IF(F6<200,

VLOOKUP((F6*10)-INT(F6)*10,'C:\AThesis\[TANKS.xls]TANKS'!O5:P14,2),

VLOOKUP((F6*10)-INT(F6)*10,'C:\AThesis\[TANKS.xls]TANKS'!O19:P28,2))

Analyzing this formula a section at a time.

VLOOKUP(F6,'C:\AThesis\[TANKS.xls]TANKS'!K3:L388,2)

This section looks up the height of fuel (F6) in the first or leftmost column of the array K3:L388. This array is located on the TANKS Database, which is in the TANKS.xls file, which is in the AThesis folder on the C: drive. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]TANKS' will be referred to as "TANKS". Excel™ will search the array in TANKS and return the corresponding gross volume of fuel in "liters" from the second (2) column, that is located to the right of the height of fuel comparison value found in the first or leftmost column.

Figure 3-9.

Example: VLOOKUP(13, A2:B4,2). This function looks up the height of fuel (13) in the first or leftmost column of the array A2:B4 shown in Figure 3-9. It will return the corresponding gross volume of fuel in "liters" from the second (2) column (i.e., column B), that is located to the right of the height of fuel comparison value found in the first or leftmost column. In this example, the answer is 92 liters.
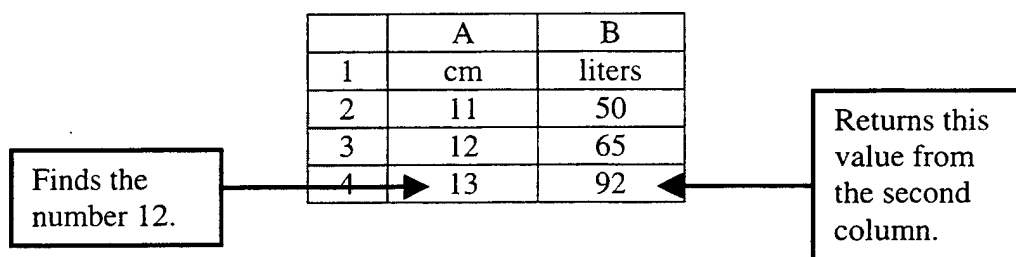
Note: for each of the automated steps, the formula is entered into the cell so that as manual entries are done, those numbers are used to calculate updated figures.

+IF(F6<200,

VLOOKUP((F6*10)-INT(F6)*10, TANKS!O5:P14,2),

VLOOKUP((F6*10)-INT(F6)*10, TANKS!O19:P28,2))

This section returns the volume of fuel that corresponds to the interpolation or millimeters (i.e., 0.1 cm) of the gauge reading. The result of this section is added to the gross volume. The first line in this section begins with an "IF" function. If the height of fuel (F6) is less than 200 cm, then it will perform the second line of the section and look up the interpolation in the range O5:P14. If the height of fuel (F6) is <u>not</u> less than 200 cm, then it will perform the third line of the section and look up the interpolation in the range O19:P28. Example: if the height of fuel (F6) = 315.3 cm. Since 315.3 is not less than 200 cm, the formula will use the third line of the above section to "look" for the 0.3 cm interpolation in the range O19:P28. Notice there are "INT" functions in both the second and third lines. This changes the centimeter fraction (i.e., millimeters) into a whole number.

> Example: Let (F6) = 315.3
>
> (F6*10)-INT(F6)*10 =
>
> (315.3 * 10)- INT(315.3)*10 =
>
> (315.3 * 10)- 315 * 10 =
>
> 3153 - 3150 = 3

The millimeters in the database interpolation table were written as whole numbers. Therefore, the millimeters in the above calculations were changed into whole numbers in order for Excel™ to be able to compare and match these figures to the whole numbers in the interpolation table.

The third step is called the "Water Cut Reading" which is the measured height of the water in the storage tank. This step is entered manually into the model in cell (F8). The fourth step is called the "Gross Water Volume" which is the amount of water that settles on the bottom of the storage tank. This step utilizes the following formula to automatically convert the "Water Cut Reading" into a gross volume:

IF(F8>0,

VLOOKUP(F8,TANKS!K3:L388,2)

+IF(F8<200,

VLOOKUP((F8*10)-INT(F8)*10,TANKS!O5:P14,2),

VLOOKUP((F8*10)-INT(F8)*10,TANKS!O19:P28,2)),0)

The only difference between this formula and the one used in step two is the first "IF" function. If there is no water in the fuel, then there is no need for calculations. The "IF" function allows the rest of the calculation to be performed if the "Water Cut Reading" is greater than zero.

The fifth step is called the "Gross Volume of Fuel" which automatically subtracts the result in step four (i.e., Gross Water Volume) from step two (i.e., Gross Volume of Fluids in Tank). The gross volume of fuel still requires API gravity and temperature corrections before it can be considered an accurate volume for inventory purposes.

The sixth step is called the "Measured API of Sample" and is entered manually into the model in cell (F11). This step is the observed API gravity of the sample taken from the tank. The seventh step is called the "Measured Temperature of API Sample" and is also entered manually into the model in cell (F12). This is the observed temperature of the sample taken from the tank.

The eighth step is called the "API at 60F from Table 5B" and utilizes the following formula to automatically correct the measured API and temperature of the sample taken, to the standard API at 60° F:

ROUND(IF(F11>0,(VLOOKUP(F12,'C:\AThesis\[TANKS.xls]API'!$A$3:$AZ$43,

MATCH(F11,'C:\AThesis\[TANKS.xls]API'!$B$2:$AZ$2,0)+1,FALSE)),0),1)

Notice that this formula is searching in a different database than the earlier steps. The API Database is the third database in the file TANKS.xls, as discussed in Chapter II. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]API' will be referred to as "API".

ROUND

(IF(F11>0,

(VLOOKUP(F12,API!$A$3:$AZ$43,

MATCH(F11, API!$B$2:$AZ$2,0)+1,FALSE)),0),1)

This formula has several nested functions and would be easier to explain starting from the center of the formula. The "MATCH" function returns a position in an array. It will search for the "Measured API of Sample" (F11) in the array $B$2:$AZ$2, and will return the position of the first value exactly equal to (F11). The array utilized for the search was the header row (i.e., top row) on the API Database. The result of this "MATCH" function will be used as the column position in the next function.

Example: given the array a:c equals "a","b","c". MATCH("b",{"a","b","c"},0) returns the value 2. The MATCH function returns the position of the matched value within the array, not the value itself. In this example, the relative position of "b" within the array"a","b","c" is the second place.

Figure 3-10. Step Eight in the Opening Inventory.

The "VLOOKUP" function in simpler terms is VLOOKUP(F12, API Array, MATCH, FALSE). Excel™ will search the leftmost column of the API Array to find an exact value equivalent to the "Measured Temperature of API Sample" (F12). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to use. A value from Table 5B is selected where the row and the column intersect. This "Value" now is part of the "IF" argument. The "IF" function in simpler terms is IF(F11>0, Value, 0). If the "Measured API of Sample" (F11) is greater than zero, then return the value of "Value". If the "Measured API of Sample" (F11) is <u>not</u> greater than zero, then return the value of zero. Let the result of the "IF" function be called "IFOutcome". This "IFOutcome" now becomes a part of the "ROUND" argument. The "ROUND" function will take the "IFOutcome" value, and round it to one decimal place. The final result is a sample that has been standardized to an API at 60° F from Table 5B.

The ninth step is called the "Temperature of Fuel in Tank" and is entered manually into the model in cell (F14). This is the overall temperature of the fuel in the tank. The tenth step is called the "Correction Factor Using Table 6B", which is the volume correction factor for fuel. This step utilizes the following formula to automatically locate and retrieve the volume correction factor in the SIXB Database:

IF(F13>0,(VLOOKUP(F14,'C:\AThesis\[TANKS.xls]SIXB'!$A$3:$AZ$43, MATCH(F13,'C:\AThesis\[TANKS.xls]SIXB'!$B$2:$AZ$2,0)+1,FALSE)),0)

Notice that this formula is searching in a different database than the earlier steps. The SIXB Database is the fourth database in the file TANKS.xls, as discussed in Chapter II. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]SIXB' will be referred to as "SIXB".

IF(F13>0,
(VLOOKUP(F14,SIXB!$A$3:$AZ$43,
MATCH(F13,SIXB!$B$2:$AZ$2,0)+1,FALSE)),0)

There are many similarities between this formula and the one explained in step eight. Because these formulas are similar, very little detail will be necessary to explain the tenth step. Starting from the center of this formula, the "MATCH" function will search for the "API at 60F from Table 5B" (F13) in the array $B$2:$AZ$2, and will

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return the <u>position</u> of the first value exactly equal to (F13). The result of this "MATCH" function will be utilized as the column position in the next function. In simpler terms, the "VLOOKUP" function will be VLOOKUP(F14, SIXB Array, MATCH, FALSE). Excel™ will search the leftmost column of the SIXB Array to find an exact value equivalent to the "Temperature of Fuel in Tank" (F14). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to utilize. A value from Table 6B is selected where the row and the column intersect. This "Value" now becomes part of the "IF" argument. The "IF" function in simpler terms is IF(F13>0, Value, 0). If the "API at 60F from Table 5B" (F13) is greater than zero, then return the value of "Value". If the "API at 60F from Table 5B" (F13) is <u>not</u> greater than zero, then return the value of zero. The final result from the "IF" function is the volume correction factor from Table 6B.

Step eleven automatically multiplies the result from step ten (i.e., Volume Correction Factor from Table 6B) with the result from step five (i.e., Gross Volume of Fuel) to come up with the "Net Quantity in Liters". This is the corrected volume of fuel in liters. The twelfth and final step automatically converts the liters into gallons by multiplying step eleven by the constant 0.264172.

3.   Closing Inventory

The closing inventory is performed after receipt of product and product has had time to settle. See Reference 4 page 3-21 for guidelines on when to perform the official gauge for the records. There are twelve steps in this area of the model, which are steps thirteen through twenty-four. These twelve steps are identical to the opening inventories, as shown in Figure 3-11. The only difference between the opening and closing inventories is the timing. The formulas and procedures are the same. Step twenty-five is the closing inventory minus the opening inventory. The outcome is the net quantity received in gallons.
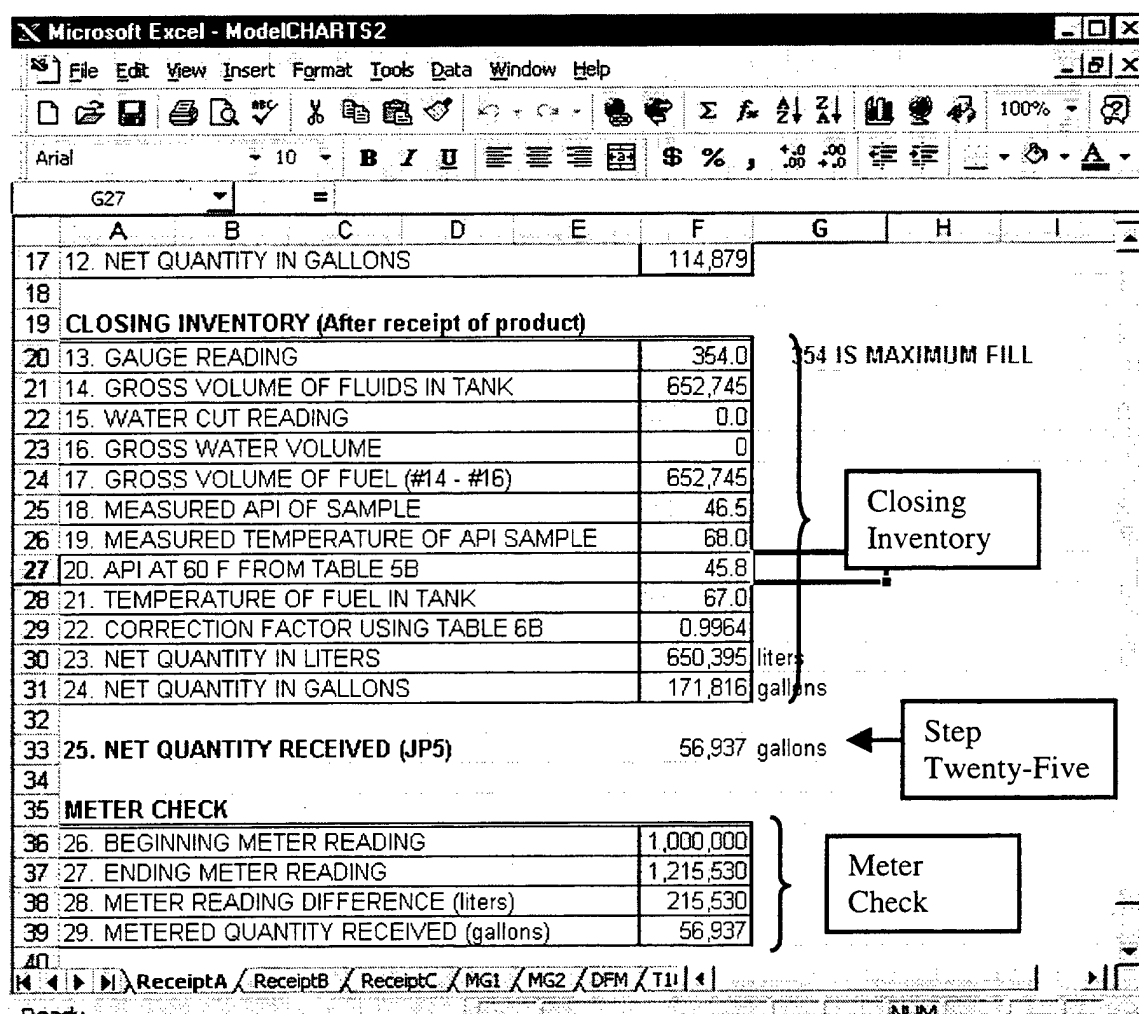
Figure 3-11. Example of Closing Inventory on Receipt Model.

E. JP5 WORKS MODEL

The purpose of this model is to provide the daily JP5 close-out inventory. This model should be one of the three main models that the Fuel Officer reviews on a daily basis. The other two models will be discussed later in Sections G (i.e., Gas Model) and H (i.e., Charts). "JP5 Works" also compares the physical and book inventory totals to determine if there are any discrepancies. This model utilizes information from all four of the databases and the other three models previously discussed.

The JP5 Works Model is divided into three areas, as shown in Figure 3-12:

- Fuel Storage Tanks Inventory
- Fuel Trucks Inventory
- Book Inventory

Microsoft Excel - ModelCHARTS2

File   Edit   View   Insert   Format

Storage Tank Inventory Area Table

Fuel Truck Inventory Area Table

Arial   10

I21

JP5 DAILY CLOSE-OUT

DATE: 08-Apr-98

TANK	GAUGE	WATER CUT	GAUGE TRUE	GROSS VOLUME	OBS API	SAMP TEMP	CORR API	TANK TEMP	CORR FACTOR	TOTAL liters	TRUCKS #	Gallons
A	85	0	85	161478	45.3	61.0	44.8	68.0	0.9959	160,815.9	934	4,416.0
B	84.6	0	84.6	167365	45.2	62.0	45.0	68.0	0.9959	166,678.8	125	1,994.2
C	198	0	198	382098	46.0	60.0	46.0	68.0	0.9958	380,493.2	318	0.0
3	70.3	3	67.3	13057	45.4	62.0	45.2	68.0	0.9959	13,003.8	319	4,827.8
4	100	0	100	25472	45.0	62.0	44.8	70.0	0.9948	25,339.5	320	4,827.8
D1	319	0	319	192983	47.0	70.0	46.1	75.0	0.9922	191,477.2	258	4,988.0
D2	232	0	232	140436	47.5	70.0	46.6	75.0	0.9921	139,326.7	115	4,642.0
D3	300.1	0	300.1	183563	44.9	69.0	44.1	72.0	0.9939	182,442.8	365	4,826.0
D4	222.6	0	222.6	133788	46.5	68.0	45.8	73.0	0.9932	132,878.4	661	4,737.0
										1,392,456.3	841	4,737.0
												39,995.8

TOTAL TANK LITERS 1,392,456

CONVERT TO GALLONS	367,848
TOTAL PIPELINE GALLONS	39,182
TRUCKS	39,996
TOTAL PHYSICAL INVENTORY	447,026

Book Inventory Area

JP-5 BOOK (yesterdays close)	450,000
RECEIVED (+)	57,058
ISSUES (-)	62,377
DEFUELED (+)	100
	444,781

REVIEWED BY:

DAILY DIFFERENCE   2,244 Gallons

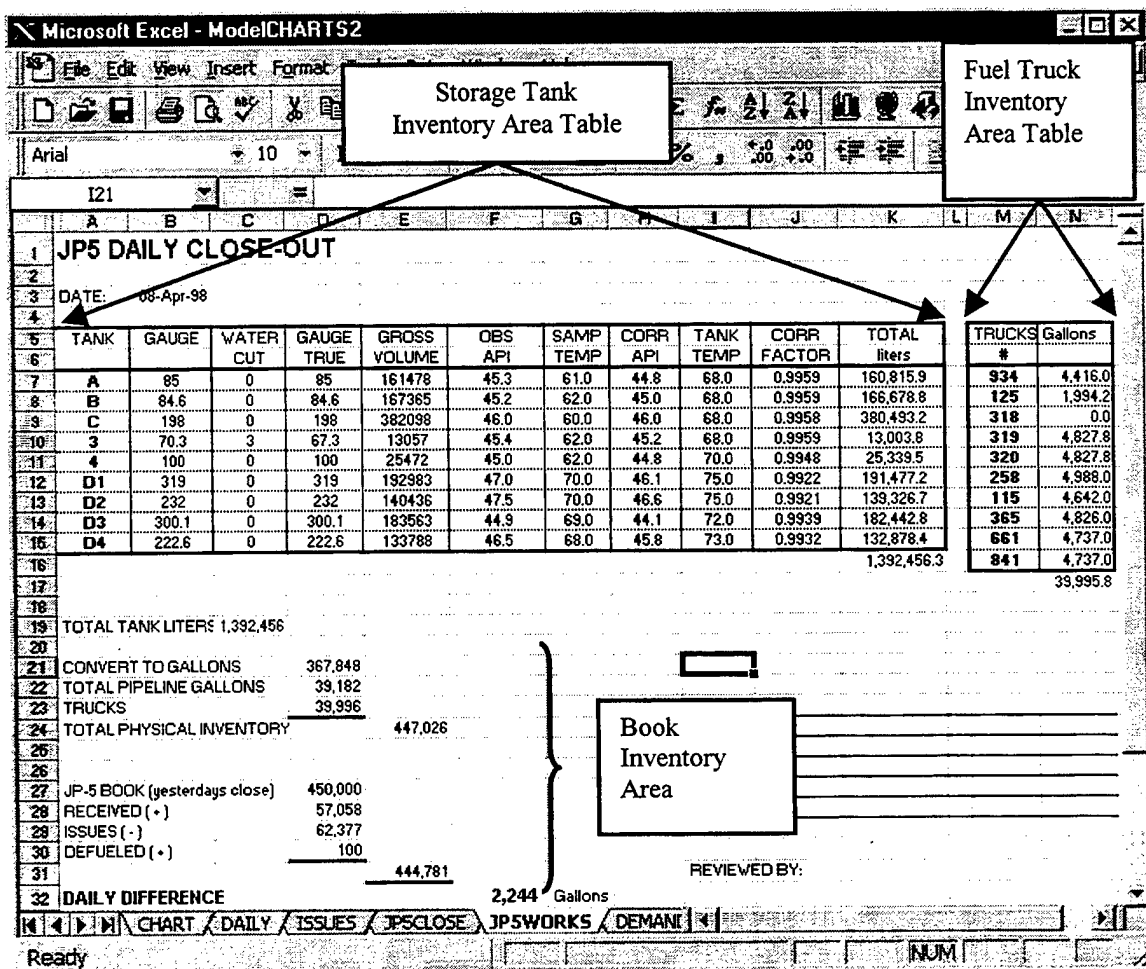CHART / DAILY / ISSUES / JPSCLOSE \ JP5WORKS / DEMAND

Ready   NUM

Figure 3-12. Example of JP5 Works Model.

1.   Terminology and Functions

The following terminology and functions are used in the JP5 Works Model:

a) *LOOKUP*

This function looks in a one-column range (known as a vector) for a value and returns a value from the same position in a second one-column range.

LOOKUP(lookup_value,lookup_vector,result_vector)

- **Lookup_value** - a value that LOOKUP searches for in the first vector (i.e., column).

- **Lookup_vector** - a range that contains only one column. Values must be in ascending order.

- **Result_vector** - a range that contains only one column. It must be the same size as lookup_vector.

Please refer to the definitions and terminology found in Section D (i.e., Receipt Model) for functions (b) though (f).

b) *VLOOKUP*

c) *IF*

d) *INT*

e) *ROUND*

f) *MATCH*

2. Storage Tanks Inventory

There are ten steps in this area of the model that convert the gross volume of fuel in storage tanks into the corrected volume. This entire area is linked to the information contained in the Daily Model, as well as the TANKS, API, and SIXB databases. No manual entries are required for any of the steps.

The first step is called the "Gauge", which is the tank gauge reading (i.e., measured height of fuel in storage tank). The link for this step looks like " =DAILY!B9 " in the formula bar. Cell (B7) is linked to the tank gauge reading information in the Daily Model. As information is updated in the Daily Model in cell (B9), Excel™ automatically updates the information on the JP5 Works Model through the use of "links".

The second step is called the "Water Cut" reading, which is the measured height of the water in the storage tank. The link for this step looks like " =DAILY!D9 " in the formula bar. The third step is called the "Gauge True" reading, which is the true height

of the fuel in the tank minus the water. This step automatically subtracts the value in step two (i.e., Water Cut) from step one (i.e., Gauge). The fourth step is called the "Gross Volume", which is the gross (i.e., uncorrected) volume of fluids in tank. This step utilizes the following formula to automatically convert the "Gauge True" reading into a gross volume:

VLOOKUP(D7,'C:\AThesis\[TANKS.xls]TANKS'!K3:L388,2)

+IF(D7<200,

VLOOKUP((D7*10)-INT(D7)*10,'C:\AThesis\[TANKS.xls]TANKS'!O5:P14,2),

VLOOKUP((D7*10)-INT(D7)*10,'C:\AThesis\[TANKS.xls]TANKS'!O19:P28,2))

Analyzing this formula a section at a time.

VLOOKUP(D7,'C:\AThesis\[TANKS.xls]TANKS'!K3:L388,2)

This section looks up the true height of fuel (D7) in the first or leftmost column of the array K3:L388. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]TANKS' will be referred to as "TANKS". Excel™ will search the array and return the corresponding gross volume of fuel in "liters" from the second (2) column, that is located to the right of the true height of fuel comparison value found in the first or leftmost column.
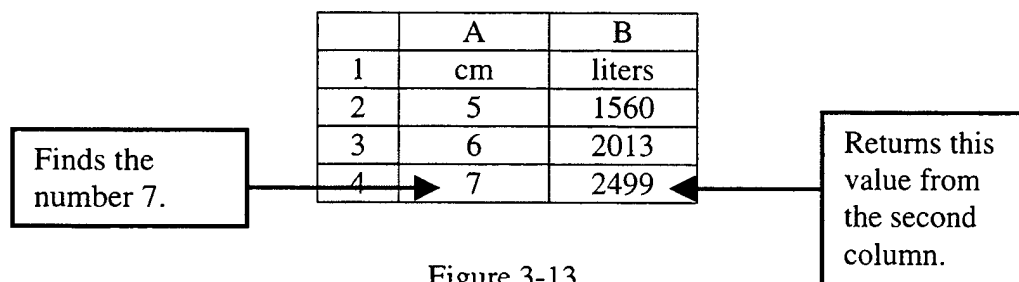

	A	B
1	cm	liters
2	5	1560
3	6	2013
4	7	2499

Finds the number 7.

Returns this value from the second column.

Figure 3-13.

Example: VLOOKUP(7,A2:B4,2). This searches for the height of fuel (7) in the first or leftmost column of the array A2:B4 shown in Figure 3-13. It will return the corresponding gross volume of fuel in "liters" from the second (2) column (i.e., column B), that is located to the right of the height of fuel comparison value found in the first or leftmost column. For this example, the answer is 2499 liters.

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+IF(D7<200,

VLOOKUP((D7*10)-INT(D7)*10, TANKS!O5:P14,2),

VLOOKUP((D7*10)-INT(D7)*10, TANKS!O19:P28,2))

This section returns the volume of fuel that corresponds to the interpolation or millimeters (i.e., 0.1 cm) of the gauge reading. The result of this section is added to the gross volume. The first line in this section begins with an "IF" function. If the true height of fuel (D7) is less than 200 cm, then it will perform the second line of the section and look up the interpolation in the range O5:P14. If the true height of fuel (D7) is <u>not</u> less than 200 cm, then it will perform the third line of the section and look up the interpolation in the range O19:P28. Example: if the true height of fuel (D7) = 195.8 cm. Since 195.8 is less than 200 cm, the formula will use the second line of the above section to "look" for the 0.8 cm interpolation in the range O5:P14. Notice there are "INT" functions in both the second and third lines. This changes the centimeter fraction (i.e., millimeters) into a whole number.

Example: Let (D7) = 195.8

(D7*10)-INT(D7)*10 =

(195.8 * 10)- INT(195.8)*10 =

(195.8 * 10)- 195 * 10 =

1958 - 1950 = 8

The millimeters in the database interpolation table were written as whole numbers. Therefore, the millimeters in the above calculations were changed into whole numbers in order for Excel™ to be able to compare and match these to the whole numbers in the interpolation table.

The fifth step is called the "Observed API" (F7) reading, which is the observed API of the sample taken from the tank. The link for this step looks like " =DAILY!E9 " in the formula bar. The sixth step is called the "Sample Temperature" reading, which is the observed temperature of the sample taken from the tank. The link for this step looks like " =DAILY!C9 " in the formula bar. Some of the links to the Daily Model are written below their cells, as shown in Figure 3-14.
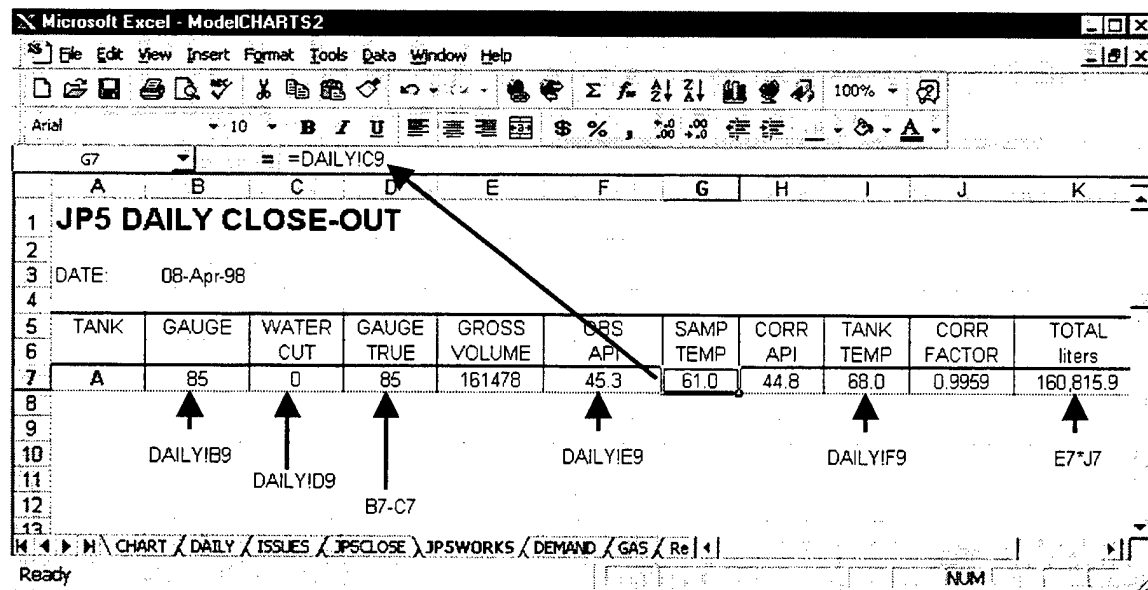
Figure 3-14. Example of Storage Tank Inventory on JP5 Works Model.

The seventh step is called the "Corrected API", which is the API at 60° F from Table 5B. This step uses the following formula to automatically correct the observed API and temperature of the sample taken, to the standard API at 60° F:

ROUND(IF(F7>0,(VLOOKUP(G7,'C:\AThesis\[TANKS.xls]API'!$A$3:$AZ$43, MATCH(F7,'C:\AThesis\[TANKS.xls]API'!$B$2:$AZ$2,0)+1,FALSE)),0),1)

Notice that this formula is searching in a different database than the earlier steps. The API Database is the third database in the file TANKS.xls, as discussed in Chapter II. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]API' will be referred to as "API".

ROUND(

IF(F7>0,

(VLOOKUP(G7,API!$A$3:$AZ$43,

MATCH(F7,API!$B$2:$AZ$2,0)+1,FALSE)),0),1)

Notice the similarities between this formula and the one explained in step eight of Section 2 (i.e., Opening Inventory) of the Receipt Model. Because these formulas are similar, very little detail will be necessary to explain the seventh step. Starting from the center of this formula, the "MATCH" function will search for the "Observed API" (F7) in

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the array \$B\$2:\$AZ\$2, and will return the <u>position</u> of the first value exactly equal to (F7). The result of this "MATCH" function will be used as the column position in the next function. The "VLOOKUP" function in simpler terms is VLOOKUP(G7, API Array, MATCH, FALSE). Excel™ will search the leftmost column of the API Array to find an exact value equivalent to the "Sample Temperature" (G7). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to use. A value from Table 5B is selected where the row and the column intersect. This "Value" now becomes part of the "IF" argument. The "IF" function in simpler terms is IF(F7>0, Value, 0). If the "Observed API" (F7) is greater than zero, then return the value of "Value". If the "Observed API" (F7) is <u>not</u> greater than zero, then return the value of zero. Let the result of the "IF" function be called "IFOutcome". This "IFOutcome" now becomes a part of the "ROUND" argument. The "ROUND" function will take the "IFOutcome" value, and round it to one decimal place. The final result is a sample that has been standardized to an API at 60° F from Table 5B.

The eighth step is called the "Tank Temperature", which is the overall temperature of the fuel in the tank. The link for this step looks like " =DAILY!F9 " in the formula bar. The ninth step is called the "Correction Factor Using Table 6B", which is the volume correction factor for fuel. This step uses the following formula to automatically locate and retrieve the volume correction factor:

IF(H7>0,(VLOOKUP(I7,'C:\AThesis\[TANKS.xls]SIXB'!\$A\$3:\$AZ\$43, MATCH(H7,'C:\AThesis\[TANKS.xls]SIXB'!\$B\$2:\$AZ\$2,0)+1,FALSE)),0)

Notice that this formula is searching in a different database than the earlier steps. The SIXB Database is the fourth database in the file TANKS.xls. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]SIXB' will be referred to as "SIXB".

IF(H7>0,
(VLOOKUP(I7,SIXB!\$A\$3:\$AZ\$43,
MATCH(H7,SIXB!\$B\$2:\$AZ\$2,0)+1,FALSE)),0)

This formula is very similar to the formula in step seven. Starting from the center of this formula, the "MATCH" function will search for the "Corrected API" (H7) in the array \$B\$2:\$AZ\$2, and will return the <u>position</u> of the first value exactly equal to (H7). The result of this "MATCH" function will be utilized as the column position in the

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next function. The "VLOOKUP" function in simpler terms is VLOOKUP(I7, SIXB Array, MATCH, FALSE). Excel™ will search the leftmost column of the SIXB Array to find an exact value equivalent to the "Tank Temperature" (I7). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to use. A value from Table 6B is selected where the row and the column intersect. This "Value" now becomes part of the "IF" argument. The "IF" function in simpler terms is IF(H7>0, Value, 0). If the "Corrected API" (H7) is greater than zero, then return the value of "Value". If the "Corrected API" (H7) is <u>not</u> greater than zero, then return the value of zero. The final result is the volume correction factor from Table 6B.

Step ten automatically multiplies the result from step nine (i.e., Volume Correction Factor from Table 6B) with the result from step four (i.e., Gross Volume of Fuel) to come up with the "Net Quantity in Liters". This is the corrected volume of fuel in liters.

3. Fuel Trucks Inventory

There is only one step in this area of the model. The following formula retrieves information from the Daily Model and the Trucks Database to determine the volume in gallons:

LOOKUP(DAILY!J9,'C:\AThesis\[TANKS.xls]TRUCKS'!G5:G57,'C:\AThesis\ [TANKS.xls]TRUCKS'!H5:H57)

The LOOKUP function is more applicable for smaller databases. A VLOOKUP function could have been used to determine the Fuel Trucks Inventory, but this gives the user another database search option.

Notice that this formula is searching in a different database. The TRUCKS Database is the second database in the file TANKS.xls, as discussed in Chapter II. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]TRUCKS' will be referred to as "TRUCKS".

LOOKUP(DAILY!J9,TRUCKS!G5:G57,TRUCKS!H5:H57)

This formula searches the LOOKUP vector (i.e., G5:G57) in the TRUCKS Database for a value equivalent to the value found in cell J9 from the Daily Model, and returns a value from the same position in the result vector (i.e., H5:H57).

Fuel must remain motionless for a sufficient length of time to allow the air bubbles to settle out in order to get an accurate gauging. To comply with this, a truck must remain motionless, which brings up the question of what good is a mobile refueler, if it is not mobile? A fuel truck does not have time for the fuel to settle between the fuel farm and the flight line. Also, due to the small quantity of fuel difference between the inch increments, interpolation for the fractions of inches is not done because each inch amounts to approximately forty gallons. Because of the small volume of fuel these trucks hold and the continuous turbulence the fuel experiences due to the trucks motion, temperature and volume corrections are not performed. A gross volume measurement from a truck is deemed acceptable.

4.   Book Inventory

This is the third and final area of the JP5 Works Model. There are ten steps to this area which are all automatic. The "Convert to Gallons" is the first step. This step converts the total volume of fuel in all the storage tanks from liters into gallons by multiplying by the constant 0.264172. The second step "Total Pipeline Gallons" is a constant because the pipes are always packed with fuel and ready to utilize (unless the fuel farm is being taken out of service). For NAS Sigonella, the constant was 39,182 gallons. Step three "Trucks" is the total gallons in the possession of the trucks. Step four "Total Physical Inventory" is the sum of the values in steps one through three, as shown in Figure 3-15.
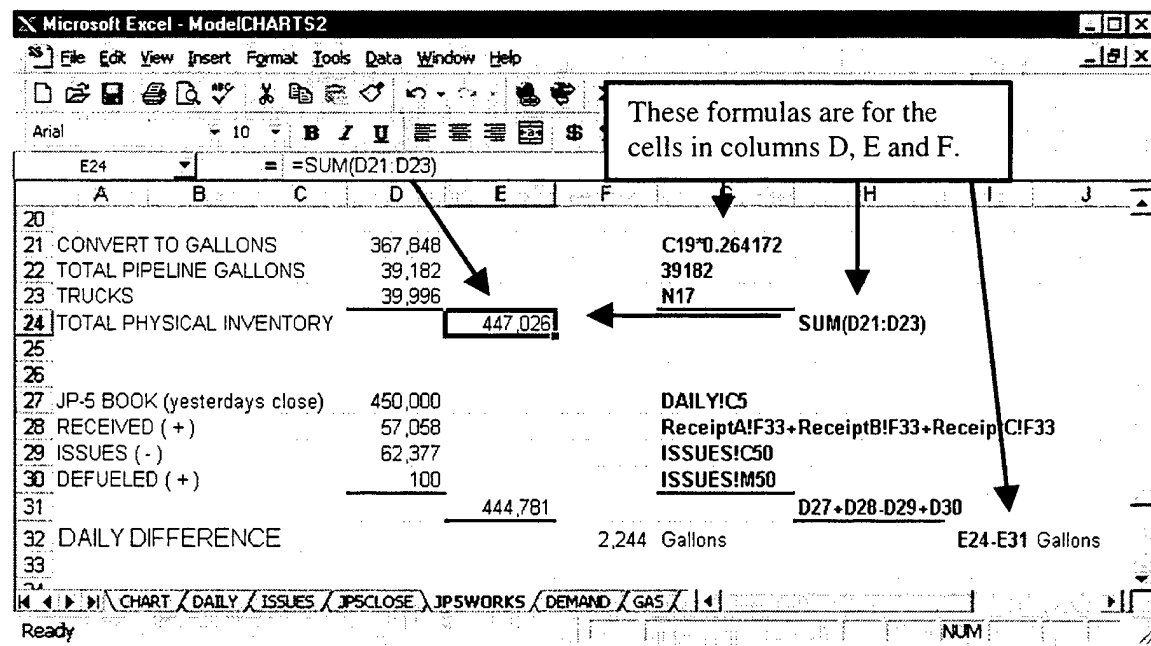
Figure 3-15. Example of Book Inventory on JP5 Works Model.

Step five "JP5 Book" is linked to the Daily Model, and retrieves the closing book inventory from the day before. Step six "Received" is linked to each of the Receipt Models created for JP5. This step sums the total amount of JP5 received for that day in gallons. Step seven "Issues" is linked to the Issues Model and returns the total issued for that day in gallons. Step eight "Defueled" is linked to the Issues Model and returns the total defueled for that day in gallons. Step nine "Book Total" takes the value in step five "JP5 Book", adds the value in step six "Received", subtracts the value in step seven "Issues", and adds the value in step eight "Defueled" to come up with a book total in gallons. Step ten subtracts step nine "Book Total" from step four "Total Physical Inventory" to come up with the daily difference.

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F. JP5 CLOSE MODEL

The purpose of this model is to provide a daily summary version of the JP5 Works Model. The JP5 Works Model is very detailed with an abundance of figures, formulas and correction factors. This model is simple and easy to read. Through links, the JP5 Works Model supplies the fuel truck volumes and all of the storage tank information to the JP5 Close Model, as shown in Figure 3-16. The Daily and JP5 Close Models are the only places that the fuel truck gaugings are displayed. The Daily supplies this information to the JP5 Close Model through links.
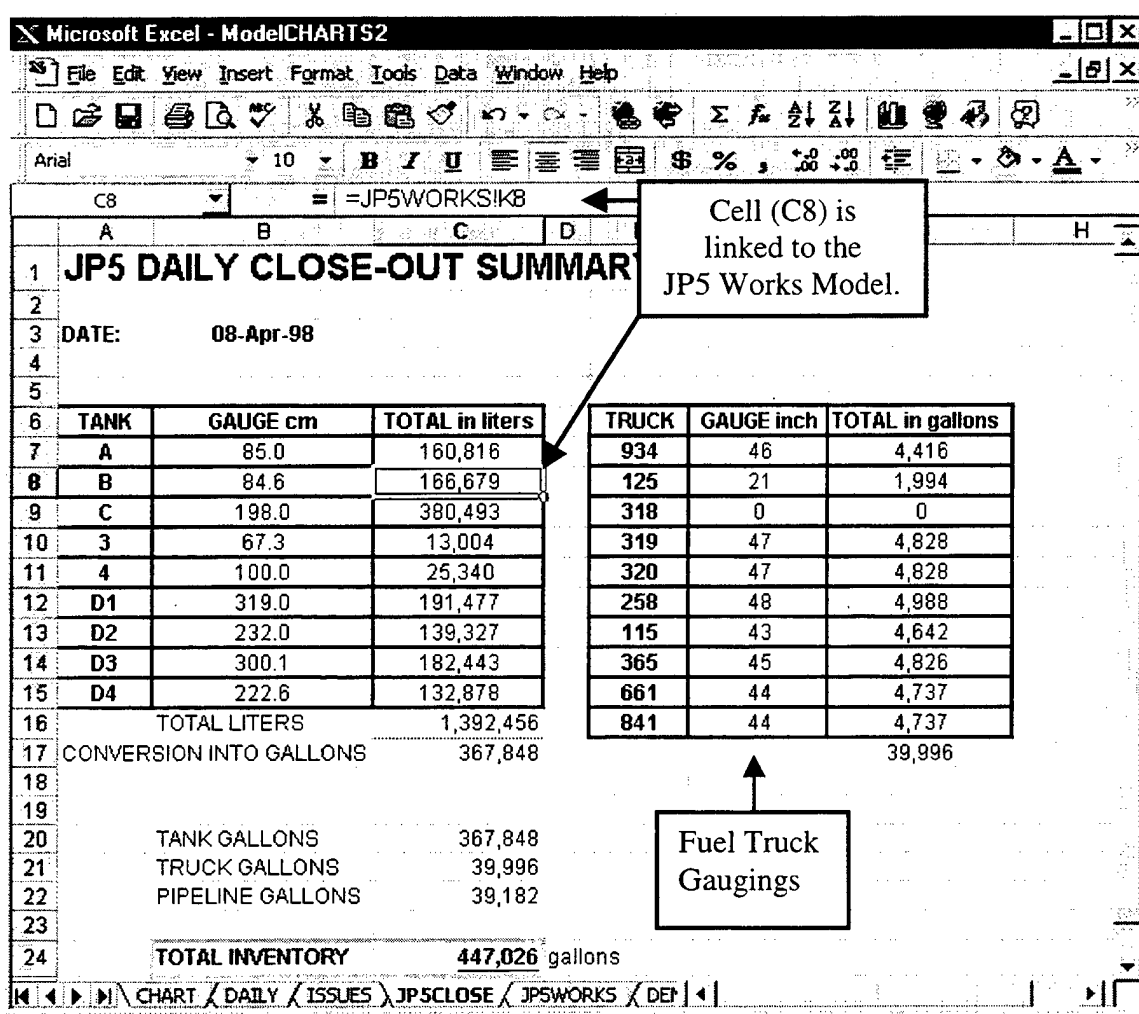
X Microsoft Excel - ModelCHARTS2

File Edit View Insert Format Tools Data Window Help

C8 = =JP5WORKS!K8

Cell (C8) is linked to the JP5 Works Model.

JP5 DAILY CLOSE-OUT SUMMARY

DATE: 08-Apr-98

TANK	GAUGE cm	TOTAL in liters		TRUCK	GAUGE inch	TOTAL in gallons
A	85.0	160,816		934	46	4,416
B	84.6	166,679		125	21	1,994
C	198.0	380,493		318	0	0
3	67.3	13,004		319	47	4,828
4	100.0	25,340		320	47	4,828
D1	319.0	191,477		258	48	4,988
D2	232.0	139,327		115	43	4,642
D3	300.1	182,443		365	45	4,826
D4	222.6	132,878		661	44	4,737
TOTAL LITERS		1,392,456		841	44	4,737
CONVERSION INTO GALLONS		367,848				39,996

Fuel Truck Gaugings

TANK GALLONS   367,848
TRUCK GALLONS   39,996
PIPELINE GALLONS   39,182

TOTAL INVENTORY   447,026 gallons

CHART / DAILY / ISSUES \ JP5CLOSE / JP5WORKS / DEF

Figure 3-16. Example of JP5 Close Model.

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G. GAS MODEL

The purpose of this model is to provide the <u>daily</u> gas station close out inventory for both gasoline and diesel fuels. This is the second of three main models that the Fuel Officer should review on a daily basis. The third model will be discussed later in Section H (i.e., Charts).

The Gas Model is divided into three areas:

- the opening inventory
- the closing inventory
- the book inventory

The databases for both diesel and gasoline are arranged in the same format. The procedures on the formulas and interpolations are the same throughout the model for both fuels, with the exception of the references to their respective databases. Therefore, only one set of procedures (i.e., gasoline) will be discussed for both fuels.

1. Terminology and Functions

The following terminology and functions are used in the Gas Model. Please refer to the definitions and terminology found in Section D (i.e., Receipt Model) for functions (a) though (e).

a) **VLOOKUP**

b) **IF**

c) **INT**

d) **ROUND**

e) **MATCH**

2. Opening Inventory

There are ten steps in this area of the model that convert the gross volume of fuel in storage tanks into the corrected volume. This entire area is linked to the information contained in the Daily Model, as well as the TANKS, API, and SIXB databases. Some of the links to the Daily Model are written below their cells as shown in Figure 3-17. Manual entries are not required for any of the steps.
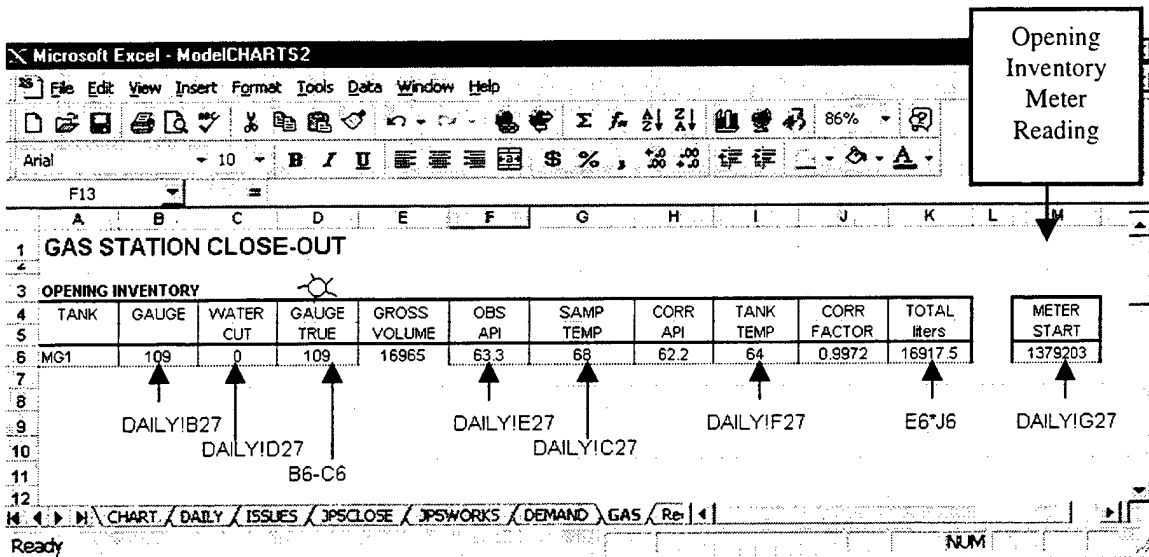
Figure 3-17. Example of Opening Inventory on Gas Model.

The first step is called the "Gauge" which is the tank gauge reading (i.e., measured height of fuel in storage tank). The link for this step looks like " =DAILY!B27 " in the formula bar. This cell is linked to the tank gauge reading information on the Daily Model. As information is updated on the Daily Model in cell (B27), Excel™ automatically updates the information on the Gas Model through the use of "links".

The second step is called the "Water Cut" reading, which is the measured height of the water in the storage tank. The link for this step looks like " =DAILY!D27 " in the formula bar. The third step is called the "Gauge True" reading, which is the true height of the fuel in the tank minus the water. This step automatically subtracts the value in step two (i.e., Water Cut) from step one (i.e., Gauge). The fourth step is called the "Gross Volume", which is the gross (i.e., uncorrected) volume of fluids in tank. This step utilizes the following formula to automatically convert the "Gauge True" reading into a gross volume:

VLOOKUP(D6,'C:\AThesis\[TANKS.xls]TANKS'!A3:B183,2)

+VLOOKUP(D6,'C:\AThesis\[TANKS.xls]TANKS'!A3:D182,4)

*((D6*10)-INT(D6)*10)

Analyzing this formula a section at a time.

VLOOKUP(D6,'C:\AThesis\[TANKS.xls]TANKS'!A3:B183,2)

This section looks up the true height of fuel (D6) in the first or leftmost column of the array A3:B183. This array is located on the TANKS Database, which is in the TANKS.xls file. This is in the AThesis folder on the C: drive. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]TANKS' will be referred to as "TANKS". Excel™ will search the array and return the corresponding gross volume of fuel in "liters" from the second (2) column, that is located to the right of the true height of fuel comparison value found in the first or leftmost column.

+VLOOKUP(D6,TANKS!A3:D182,4)

*((D6*10)-INT(D6)*10)

This section returns the volume of fuel that corresponds to the interpolation or millimeters (i.e., 0.1 cm) of the gauge reading. The result of this section is added to the gross volume. The interpolation per millimeter is located in the fourth column of the Tanks Database for each of the storage tanks in this model, as shown in Figure 3-18.

	Comparison Value Column		Interpolation Column		Comparison Value Column			Interpolation Column

	A	B	C	D	E	F	G	H	J
1	MOGAS 1 AND 2					DIESEL			
2	cm	liters	gallons	Interpolate		cm	liters	gallons	Interpolate
3	0	0	0	0.0		0	0	0	0.0
4	1	67	17	4.0		1	67	17	3.8
5	2	107	28	4.8		2	105	27	4.7
6	3	155	41	5.5		3	152	40	5.5
7	4	210	55	6.2		4	207	54	6.0
8	5	272	72	6.8		5	267	70	6.6
9	6	340	89	7.2		6	333	88	7.2
10	7	412	109	7.8		7	405	107	7.6
11	8	490	129	8.2		8	481	127	8.0
12	9	572	151	8.6		9	561	148	8.5
13	10	658	173	9.0		10	646	170	8.9

Figure 3-18. Example of Tanks Database.

The first line in this section begins with a "VLOOKUP" function. This function searches the true height of fuel (D6) in the first or leftmost column of the array A3:D182 in the Tanks Database. It will return the interpolation volume of fuel in "liters" per millimeter from the fourth (4) column, that is located to the right of the true height of fuel comparison value found in the first or leftmost column. The second line in this section then multiplies this interpolation volume of fuel in "liters" per millimeter by the proper amount of millimeters. Notice there is an "INT" function in this second line. This function changes the centimeter fraction (i.e., millimeters) into a whole number.

Example: Let (D6) = 9.8   Let (D6) = 9.8

(D6*10)-INT(D6)*10 =   **VLOOKUP(D6,TANKS!A3:D182,4) =**

(9.8 * 10)- INT(9.8)*10 =   8.6 l/mm

(9.8 * 10)- 9 * 10 =   from Figure 3-14.

98 - 90 = 8 mm

Interpolated Volume = 8.6 l/mm * 8 mm = 68.8 liters

The millimeters in the database interpolation table are written as whole numbers. The first line in this section returns a value in liters/millimeter (l/mm), which is then multiplied by the second line in millimeters (mm), and the result (i.e., l/mm * mm = liters) is the interpolated volume in liters.

The fifth step is called the "Observed API" reading, which is the observed API of the sample taken from the tank. The link for this step looks like " =DAILY!E27 " in the formula bar. The sixth step is called the "Sample Temperature" reading. This step is the observed temperature of the sample taken from the tank. The link for this step looks like " =DAILY!C27 " in the formula bar. The seventh step is called the "Corrected API". This step is the API at 60° F from Table 5B. This step also uses the following formula to automatically correct the observed API and temperature of the sample taken, to the standard API at 60° F:

ROUND(IF(F6>0,(VLOOKUP(G6,'C:\AThesis\[TANKS.xls]API'!$A$48:$AZ$86,
MATCH(F6,'C:\AThesis\[TANKS.xls]API'!$B$47:$AZ$47,0)+1,FALSE)),0),1)

Notice that this formula is searching in a different database than the earlier steps. The API Database is the third database in the file TANKS.xls. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]API' will be referred to as "API".

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ROUND(

IF(F6>0,

(VLOOKUP(G6,API!$A$48:$AZ$86,

MATCH(F6,API!$B$47:$AZ$47,0)+1,FALSE)),0),1)

Starting from the center of this formula, the "MATCH" function will search for the "Observed API" (F6) in the array $B$47:$AZ$47, and will return the <u>position</u> of the first value exactly equal to (F6). The result of this "MATCH" function will be used as the column position in the next function. The "VLOOKUP" function in simpler terms is VLOOKUP(G6, API Array, MATCH, FALSE). Excel™ will search the leftmost column of the API Array to find an exact value equivalent to the "Sample Temperature" (G6). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to utilize. A value from Table 5B is selected where the row and the column intersect. This "Value" now becomes part of the "IF" argument. In simpler terms, the "IF" function is IF(F6>0, Value, 0). If the "Observed API" (F6) is greater than zero, then the "IF" function returns the value of "Value". If the "Observed API" (F6) is <u>not</u> greater than zero, then the "IF" function returns the value of zero. The result of the "IF" function is called "IFOutcome". This "IFOutcome" now becomes a part of the "ROUND" argument. The "ROUND" function will take the "IFOutcome" value, and round it to one decimal place. The final result is a sample that has been standardized to an API at 60° F from Table 5B.

The eighth step is called the "Tank Temperature", which is the overall temperature of the fuel in the tank. The link for this step looks like " =DAILY!F27 " in the formula bar. The ninth step is called the "Correction Factor Using Table 6B", which is the volume correction factor for fuel. This step uses the following formula to automatically locate and retrieve the volume correction factor:

IF(H6>0,(VLOOKUP(I6,'C:\AThesis\[TANKS.xls]SIXB'!$A$48:$AZ$86,

MATCH(H6,'C:\AThesis\[TANKS.xls]SIXB'!$A$47:$AZ$47,0)+1,FALSE)),0)

Notice that this formula is searching in a different database than the earlier steps. The SIXB Database is the fourth database in the file TANKS.xls. To simplify the following discussion, 'C:\AThesis\[TANKS.xls]SIXB' will be referred to as "SIXB".

IF(H6>0,

(VLOOKUP(I6,SIXB!$A$48:$AZ$86,

MATCH(H6,SIXB!$A$47:$AZ$47,0)+1,FALSE)),0)

This formula is very similar to the formula in step seven. Starting from the center of this formula, the "MATCH" function will search for the "Corrected API" (H6) in the array $A$47:$AZ$47, and will return the position of the first value exactly equal to (H6). The result of this "MATCH" function will be used as the column position in the next function. In simpler terms, the "VLOOKUP" function is VLOOKUP(I6, SIXB Array, MATCH, FALSE). Excel™ will search the leftmost column of the SIXB Array to find an exact value equivalent to the "Tank Temperature" (I6). This step relates to Excel™ which row in the database to use. Remember, the "MATCH" lets Excel™ know which column to use. A value from Table 6B is selected where the row and the column intersect. This "Value" now becomes part of the "IF" argument. In simpler terms, the "IF" function is IF(H6>0, Value, 0). If the "Corrected API" (H6) is greater than zero, then the "IF" function returns the value of "Value". If the "Corrected API" (H6) is not greater than zero, then the "IF" function returns the value of zero. The final result is the volume correction factor from Table 6B.

Step ten automatically multiplies the result from step nine (i.e., Volume Correction Factor from Table 6B) with the result from step four (i.e., Gross Volume of Fuel) to figure the "Net Quantity in Liters". This is the corrected volume of fuel in liters.

Additionally, as part of the opening inventory, the meter reading for the pump is automatically entered in column "M". The link for this step looks like " =DAILY!G27 " in the formula bar.

3. Closing Inventory

The closing inventory is performed at the end of the day after fuel issues have been terminated and the pumps secured. There are ten steps in this area of the model which are steps eleven through twenty. These ten steps are identical to the opening inventories. The only difference between the opening and closing inventories is the timing. The formulas and procedures are the same. The links in this area will be connected to the gas station's closing information in the Daily Model, as is shown in

Figure 3-19. The closing meter reading for the pump is also automatically updated though it's link with the Daily Model.
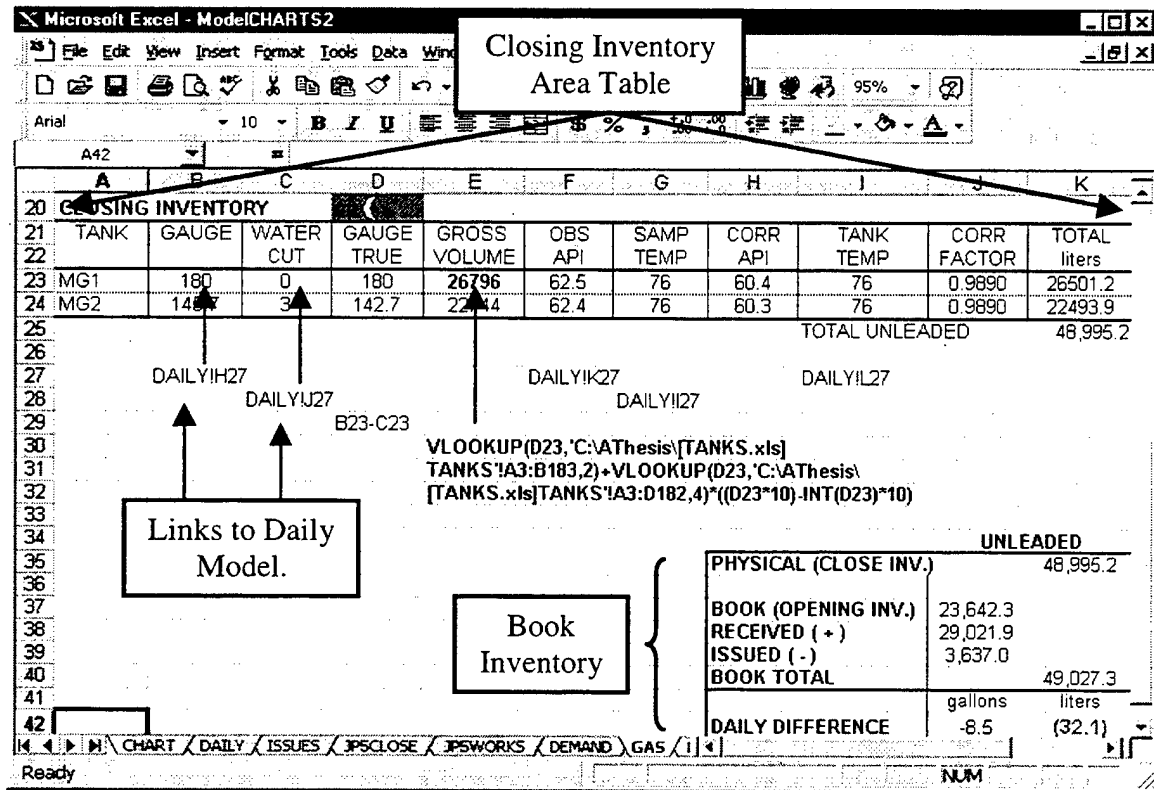

Figure 3-19. Example of Closing Inventory on Gas Model.

4. Book Inventory

This area automatically compares the Book Total (i.e., Opening Inventory plus the Receipts Total minus the Issues Total) with the Closing Inventory to determine if there are any discrepancies. The issues total is the "Opening Inventory Meter Reading" subtracted from the "Closing Inventory Meter Reading". The Receipts total is the sum of all the gasoline received for that day and is linked to each of the Receipt Models created for gasoline. The "Book Inventory" which is in liters, is automatically converted into gallons by multiplying by the constant 0.264172.

H.   CHARTS MODEL

This model graphically represents the total JP5 fuel inventory ready for issue from the storage tanks and the total available storage tank space, as is shown in Figure 3-20. Separate charts can be created with Excel's™ chart wizard for other types of fuels.
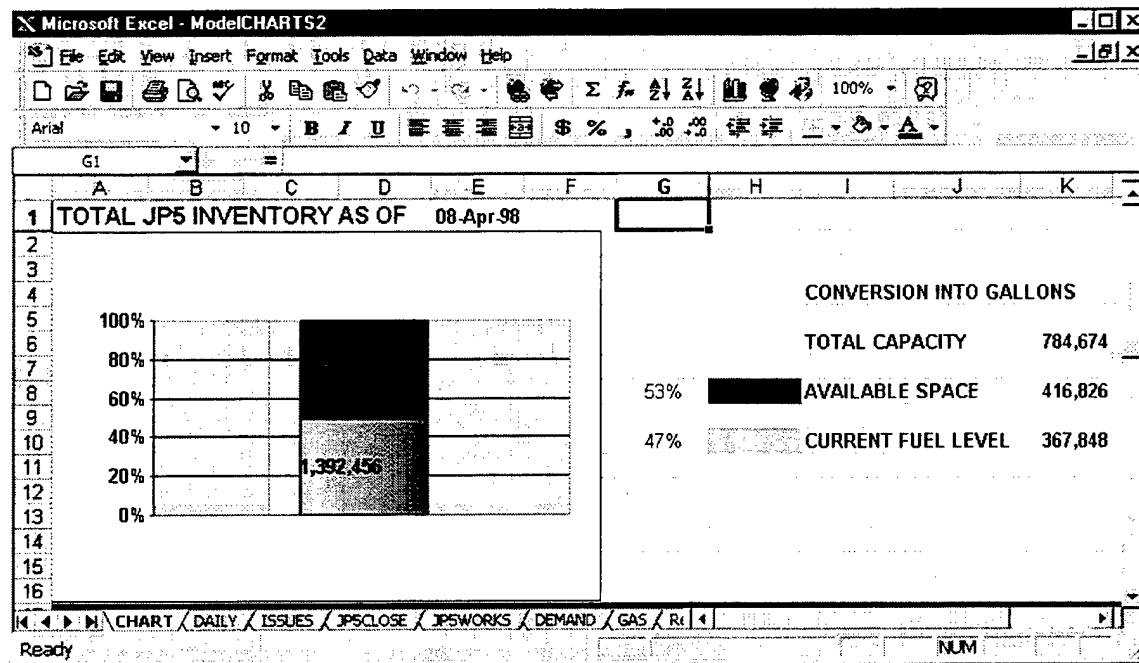

Figure 3-20. Example of Total Inventory Chart.

The model also displays the JP5 fuel level and available storage space in each individual storage tank, as is shown in Figure 3-21. This model is automatically updated daily through links with the JP5 Close Model. Please refer to the Users Guide located in Appendix C for complete instructions on this model's construction.
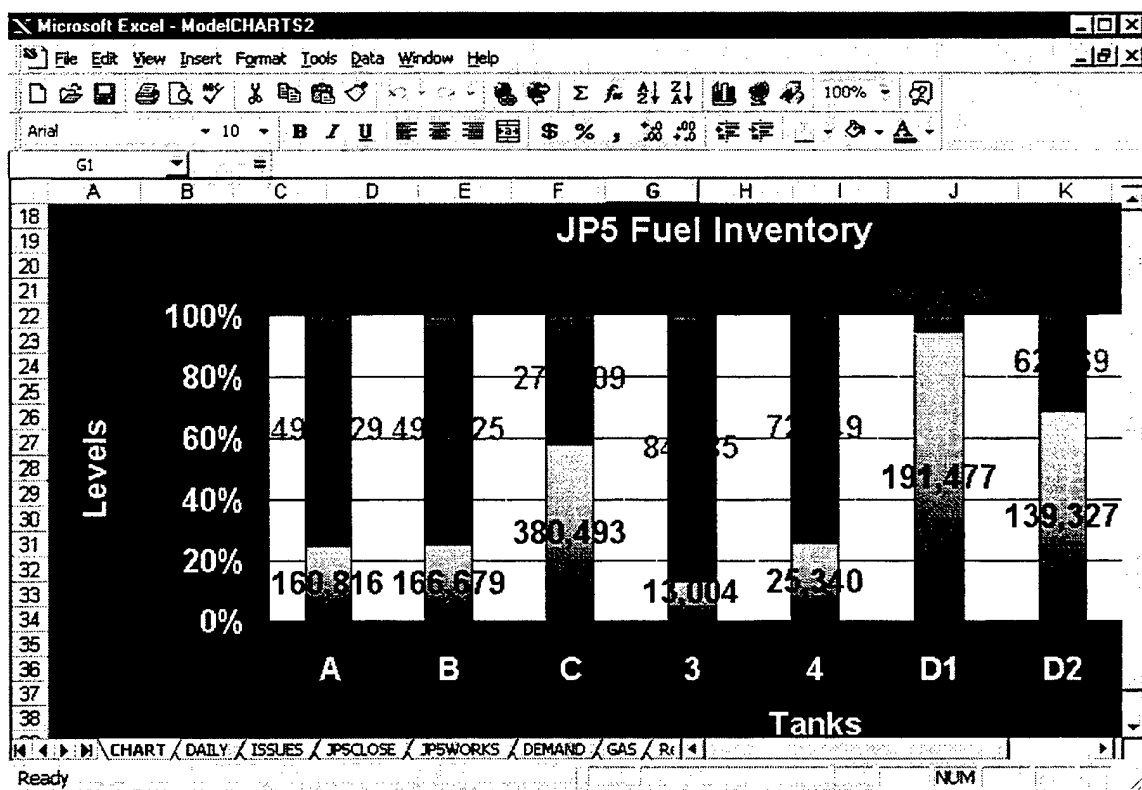
Figure 3-21. Example of Individual Storage Tank Levels Chart.

This is the third of three models that the Fuel Officer should review on a daily basis. These visuals provide the Fuel Officer an accurate daily snapshot of their fuel inventory levels and available storage tank capacities.

I. DEMAND MODEL

The purpose of this model is to provide the ability to forecast future fuel inventory ordering needs for Navy fuel farms. The Demand Model has three manual entries and is updated daily. The Fuel Officer should review this model at the end of the month prior to making an order for fuel and to check demand. The Demand Model should also be printed on the last day of the month to provide a record of the total daily demands. The model is divided into four areas:

- Daily Demand - lists the total issues for each day of the current month.
- Monthly Demand - represents the total issues for past months.

- Six Month Moving Average - presents an average monthly demand using historical data.
- Annual Demand - represents the total issues from calendar years (i.e., January through December) past.

1. Terminology and functions

The following terminology and functions are used in the Demand Model:

a) IF

Please refer to the definition found in Section D (i.e., Receipt Model).

b) SUM

Adds all the numbers in a range of cells.

SUM(number1,number2,...)

- **Number1,number2** - are the arguments for which the total value or sum is wanted. If an argument is an array, only numbers in that array are counted.

  Examples: SUM(3,2,7) equals 12

  If cells A2:E2 contain 5, 15, 30, 40, and 50:

  SUM(A2:E2) equals 140

c) "$"

In a formula, Absolute Cell Reference is the exact address of a cell, regardless of the position of the cell that contains the formula. An absolute reference takes the form $A$2, $B$7, etc.

d) MOD

Returns the remainder after a number is divided by a divisor.

MOD(number, divisor)

- **Number** - the number for which the remainder is wanted to be found.
- **Divisor** - the number by which the number is to be divided.

  Examples: MOD(13,7) equals 6. 13 can be divided by 7 one time with a remainder of 6.

  MOD(13,3) equals 1. 13 can be divided by 3 four times with a remainder of 1.

e) *Macro*

If a task is performed repeatedly in Excel™, the task can be automated with a macro. A macro is a series of commands and functions that are stored in a Visual Basic module and can be utilized whenever needed to perform the task. The macro is recorded just as music is recorded with a tape recorder. The macro is then used to repeat, or "play back", the commands.

Before recording or writing a macro, plan the steps and commands the macro is to perform. If a mistake is made when recording the macro, it is best to delete the current recording and start over.

2. Daily Demand

This area records the total daily issues for the current month. This model receives its daily demand information from a link to the Issue Model. All issues for the day should be completed prior to updating the Demand Model. Therefore, the last model of the day to be edited should be the Demand Model.

Even though the current date is displayed, this model requires the month, day, and year to be entered manually. The model utilizes these entries to control certain cells and format. This model also has the ability to change the number of days displayed to reflect the actual number of days in a particular month. For example, February has 28 days unless it's a leap year, and then there are 29 days. In the daily demand area, 28 days will be displayed for February unless it's a leap year, for which 29 days will be displayed, as shown in Figure 3-22.
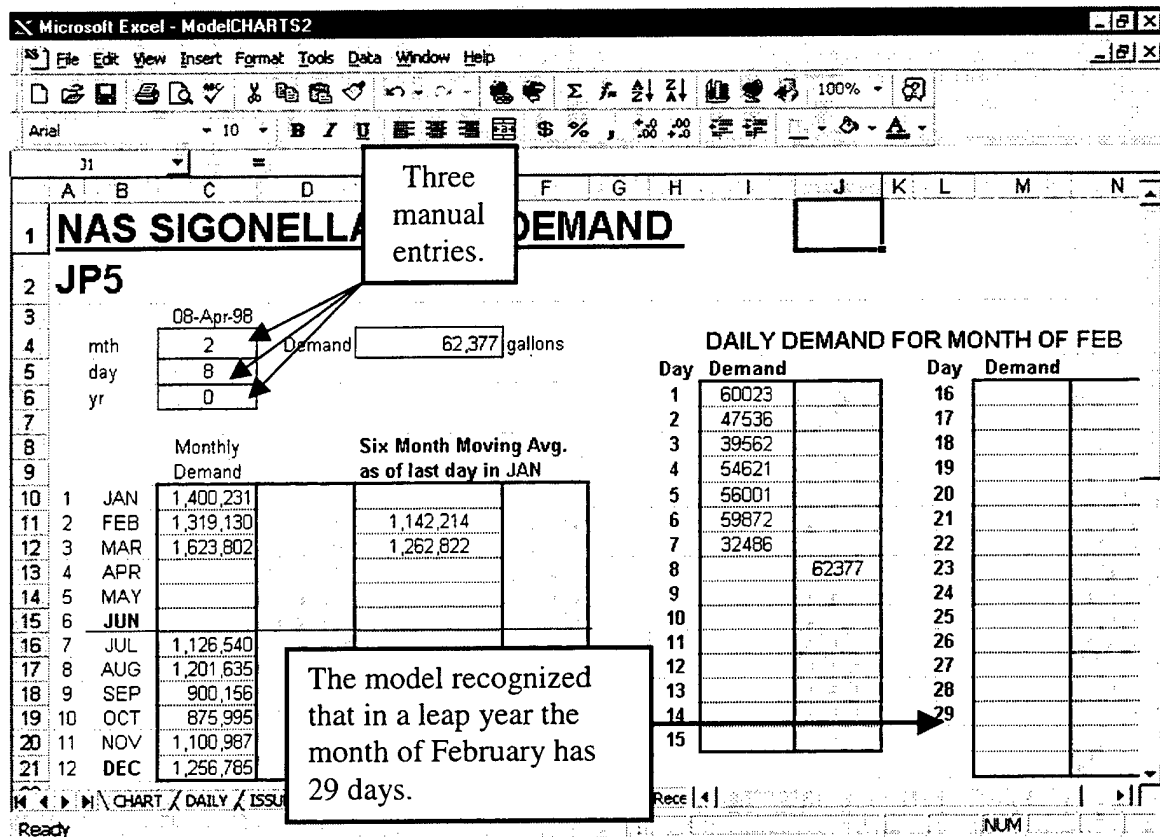
Microsoft Excel - ModelCHARTS2

File Edit View Insert Format Tools Data Window Help

NAS SIGONELLA [Three manual entries.] **DEMAND**

JP5

08-Apr-98

| | mth | 2 | Demand | 62,377 | gallons |

| | day | 8 |
| | yr | 0 |

			Monthly Demand	Six Month Moving Avg. as of last day in JAN
10	1	JAN	1,400,231	
11	2	FEB	1,319,130	1,142,214
12	3	MAR	1,623,802	1,262,822
13	4	APR		
14	5	MAY		
15	6	JUN		
16	7	JUL	1,126,540	
17	8	AUG	1,201,635	
18	9	SEP	900,156	
19	10	OCT	875,995	
20	11	NOV	1,100,987	
21	12	DEC	1,256,785	

DAILY DEMAND FOR MONTH OF FEB

Day	Demand		Day	Demand
1	60023		16	
2	47536		17	
3	39562		18	
4	54621		19	
5	56001		20	
6	59872		21	
7	32486		22	
8		62377	23	
9			24	
10			25	
11			26	
12			27	
13			28	
14			29	
15				

[The model recognized that in a leap year the month of February has 29 days.]

Ready   NUM

Figure 3-22. Leap Year Example.

The following formula decides whether to display, or not display the 29th:

IF(C4=2,IF((MOD(C6,4))=0,29,""),29)

Presenting the formula in this fashion will make it easier to explain.

IF(C4=2,

        IF((MOD(C6,4))=0,**29**,""),

                      29)

If the month entered in cell (C4) is two, and if the year in cell (C6) is divisible by four with a remainder of zero (e.g., the leap year 2000) then write **29**. If the month entered in cell (C4) is two, and if the year in cell (C6) is not divisible by four with a remainder of zero then write "" (i.e., leave the cell blank). If the month entered in cell (C4) is not two, Excel™ will enter 29. All other months have a 29th day.

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The following formula is utilized for the 30th day:

IF(C4=2,"",30)

If the month entered in cell (C4) is two (i.e., February), then write "" (i.e., leave the cell blank). If the month entered in cell (C4) is <u>not</u> two, Excel™ will enter 30. All months except February have a 30th day.

The formula that recognizes the 31st day is:

IF(C4=2,"",IF(C4=4,"",IF(C4=6,"",IF(C4=9,"",IF(C4=11,"",31)))))

Which is the same as:

IF(C4=2,"",

    IF(C4=4,"",

        IF(C4=6,"",

            IF(C4=9,"",

                IF(C4=11,"",

                    31)))))

If the month entered in cell (C4) is two (i.e., February), then enter "" (i.e., leave the cell blank). If the month entered in cell (C4) is <u>not</u> two, Excel™ will then proceed to the next "IF" statement. If the month entered in cell (C4) is four (i.e., April), then enter "" (i.e., leave the cell blank). If the month entered in cell (C4) is <u>not</u> four, Excel™ will then proceed to the next "IF" statement. Excel™ continues this process until it has "ruled out" all of the months with thirty days (i.e., April, June, September, November) and February. After making that determination, the formula enters 31 for the months with thirty-one days.

To record the daily demand in this area, the following formula copies the demand data from cell (E4) to the right of the appropriate day:

IF(($C$5)=1,$E$4,"")

If the day entered in cell (C5) is one (i.e., the first day of the month), then enter the daily demand data located in cell $E$4. If the day entered in cell (C5) is <u>not</u> one, then enter "" (i.e., leave the cell blank). This procedure is the same for each day in the month.

All of the formulas in this model are "hidden" behind gray cell shading. Hiding the formulas helps to secure the user's accuracy in calculations and prevent accidental "cell clearing". There will be deliberate cell clearing in the sections to follow.

On the last day of the month, after the macro (i.e., explained in Section Five "Annual Demand") has been utilized, a copy of the model should be printed and retained. This provides a summary sheet of all the daily issues for that month. This area exclusively stores the daily information for the current month. After the printout has been made, all daily entries in this area should be cleared. The next month starts a new list of daily demands.

3. Monthly Demand

This area records the total monthly issues from previous months. The forecasting method discussed in the next section will utilize this historical data to determine a six-month moving average. At the end of the month, the following formula sums the daily demands and records this total in the monthly demand area:

IF($C$4=1,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"")

Which is the same as:

IF($C$4=1,

IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"")

All of the cell references are absolute (i.e., $C$4) to prevent the formula from changing as it is copied down the column. If the month entered in cell (C4) is one (i.e., January) and the day entered in cell (C5) is thirty-one, then sum the daily demands in the range (I6) through (I20) (i.e., the 1st though the 15th) and the range (M6) through (M21) (i.e., the 16th though the 31st). If the month entered in cell (C4) is one (i.e., January) and the day entered in cell (C5) is <u>not</u> thirty-one, then enter "" (i.e., leave the cell blank). If the month entered in cell (C4) is <u>not</u> one (i.e., January), then enter "" (i.e., leave the cell blank). This formula is similar for the other months with thirty-one days.

Cell (C4) will change automatically for the months with thirty days (i.e., April, June, September, and November) and cell (C5) will equal 30. February's formula is unique. The formula realizes the leap year and adds a day to the month. The following formula is for February's Monthly Demand:

IF($C$4=2,IF((MOD(C6,4))=0,IF(C5=29,(SUM(I7:I21,M7:M19)),""),IF($C$5=28,(S UM(I7:I21,M7:M18)),"")),"")

Which is the same as:

IF($C$4=2,

IF((MOD(C6,4))=0,

IF(C5=29,(SUM(I6:I20,M6:M19)),""),

IF($C$5=28,(SUM(I6:I20,M6:M18)),"")),"")

If the month entered in cell (C4) is two (i.e., February), the year entered in cell (C6) is divisible by four with a remainder of zero (e.g., 2000) and the day in cell (C5) is twenty-nine, then sum the daily demands in the range (I6) through (I20) and (M6) through (M19) (i.e., the 1st though the 29th), as shown in Figure 3-23. If the month entered in cell (C4) is two (i.e., February), the year is not divisible by four with a remainder of zero (i.e., 2000) and the day in cell (C5) is twenty-eight, then sum the daily demands in the range (I6) through (I20) and (M6) through (M18) (i.e., the 1st though the 28th). If the month entered in cell (C4) is not two (i.e., February), then enter "" (i.e., leave the cell blank).
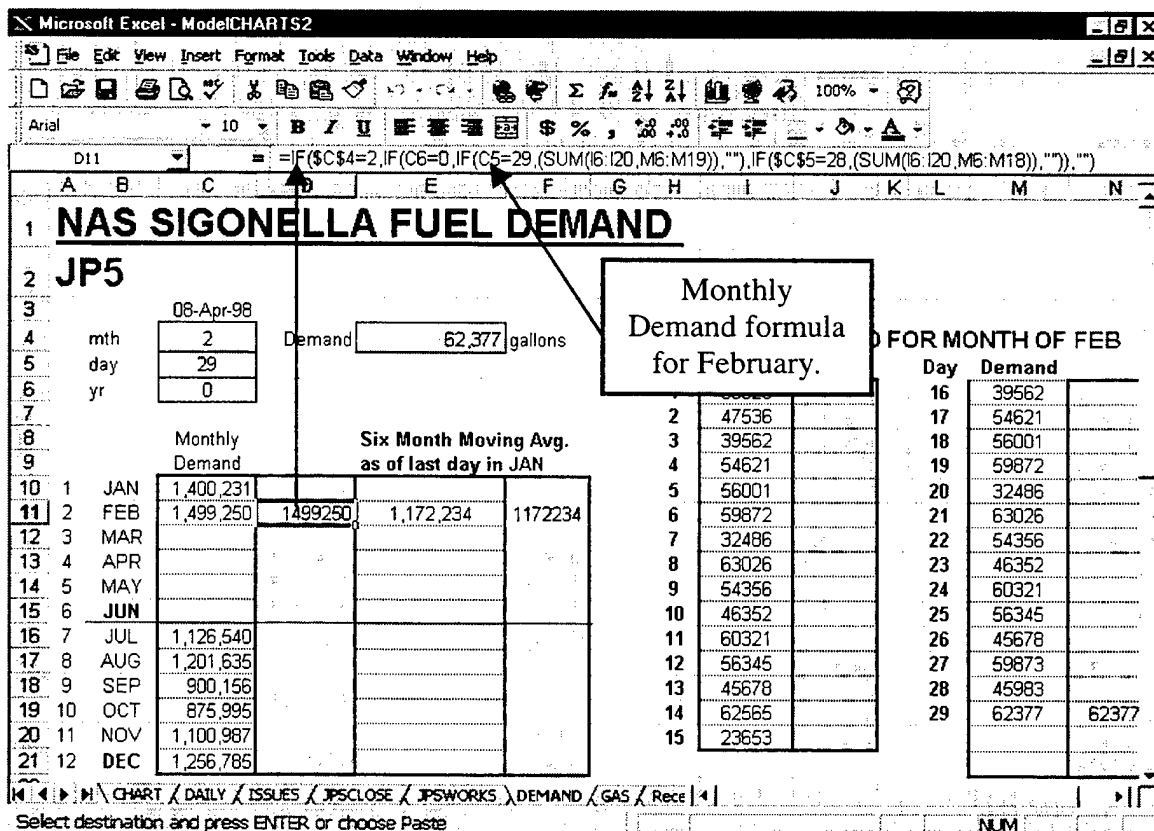
Figure 3-23. Example of a Leap Year in Monthly Demand Area.

4. Six Month Moving Average

This area utilizes a "Six Month Moving Average" to forecast or predict a monthly demand. The number of months in the moving average can be expanded or contracted to meet the user's needs. This area assists the Fuel Officer in making a more informed decision prior to ordering a shipment of fuel. The range in the formulas will change each month. This is the "moving" portion of the forecast. Example: July's forecast will consist of the previous six months (i.e., JAN, FEB, MAR, APR, MAY, JUN). August's forecast will consist of the previous six months (i.e., FEB, MAR, APR, MAY, JUN, JUL). Notice that for August's forecast, January is not included, but July is.

The forecast for February is run on the last day of January and looks like:

IF($C$4=1,IF($C$5=31,(SUM(C17:C21)+C10)/6,""),"")

If the month entered in cell (C4) is one (i.e., January), and the day entered in cell (C5) is thirty-one then sum the monthly demands in the range (C17) through (C21) plus (C10) (i.e., August through December plus January). The sum is then divided by six to determine a monthly average. If the month entered in cell (C4) is one (i.e., January), and the day entered in cell (C5) is <u>not</u> thirty-one then enter "" (i.e., leave the cell blank). If the month entered in cell (C4) is <u>not</u> one (i.e., January), then enter "" (i.e., leave the cell blank).

The forecast for March, which is generated on the last day of February, is different than other forecasts due to the leap year.

IF($C$4=2,IF((MOD(C6,4))=0,IF(C5=29,(SUM(C18:C21)+C10+C11)/6,""),
IF($C$5=28,(SUM(C18:C21)+C10+C11)/6,"")),"")

Which is the same as:

IF($C$4=2,

      IF((MOD(C6,4))=0,

            IF(C5=29,(SUM(C18:C21)+C10+C11)/6,""),

            IF($C$5=28,(SUM(C18:C21)+C10+C11)/6,"")),"")

In a leap year, if the month is February and the day is the 29th, then add the monthly demands from September through February. Take this sum and divide it by six to determine the average monthly demand. This formula also determines if the year is <u>not</u> a leap year and the month is February but the day is the 28th, then it will add the monthly

demands from September through February. Take this sum and divide it by six to arrive at an average monthly demand.

In the model, the user should focus on a line drawn through the "Monthly Demand" and the "Six Month Moving Average" areas after the month of June, as shown in Figure 3-24. The monthly demand area needs to be partially cleared twice. The first clearing occurs on the last day of June, after the macro has been run. The monthly demands and six-month moving averages for July through December are cleared. The macro is set up so that a new forecast will be added to the old one if the area is not cleared, resulting in an erroneous forecast. The second clearing occurs on the last day of December, after the macro has been run. The monthly demands and six-month moving averages for January through June are cleared.
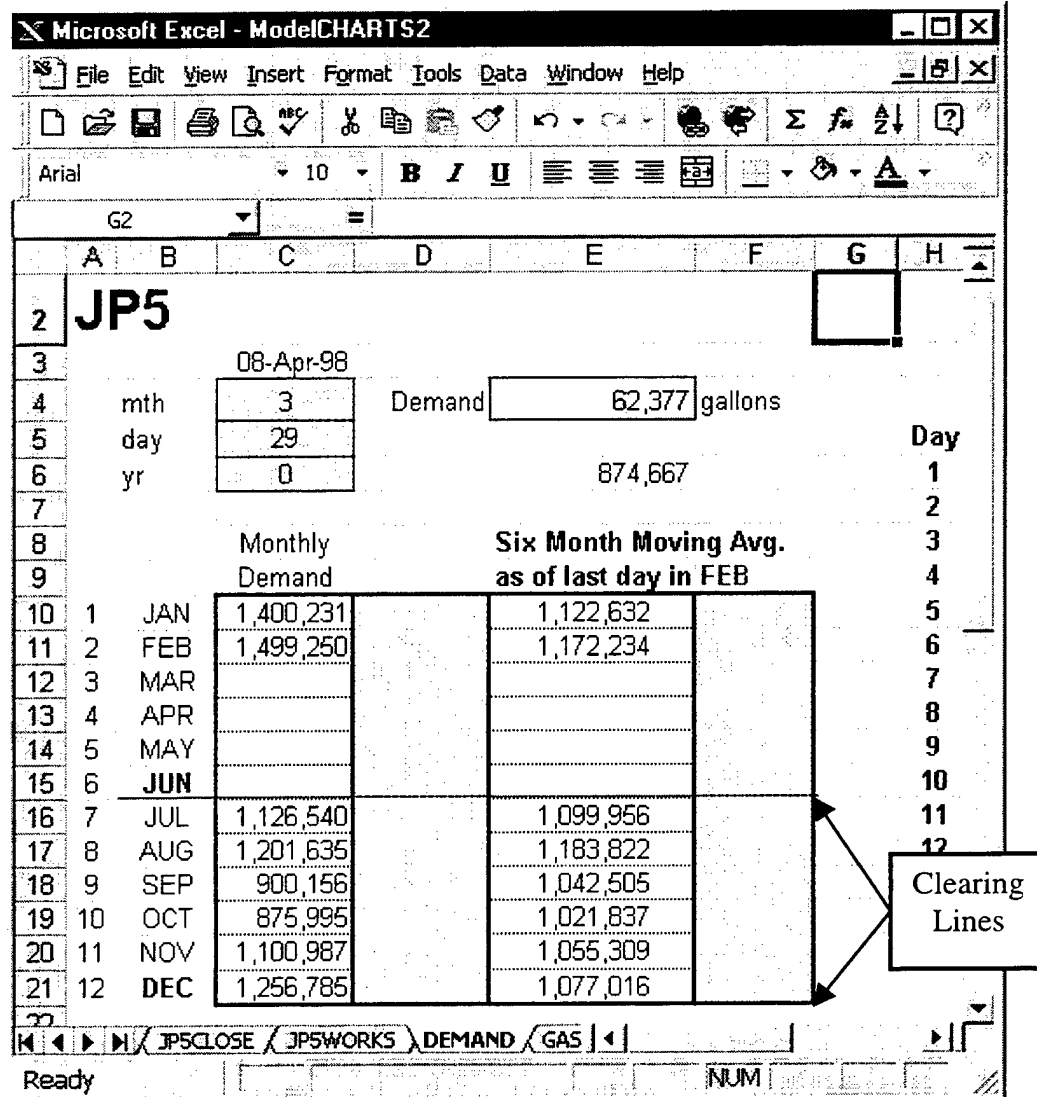
Figure 3-24. Example of Monthly Demand and Six Month Moving Average Areas.

5. Annual Demand

This area records the total annual issues for the twelve months of the calendar year. It is recorded on the 31st day of December. The following formula is used to report the "Annual Demand" for the year 1998:

IF(C6=98,IF(C4=12,IF(C5=31,SUM(C10:C21),""),""),"")

Which is the same as:

IF(C6=98,

       IF(C4=12,

              IF(C5=31,SUM(C10:C21),""),""),"")

If the year (C6) is 1998, the month (C4) is December and it is the 31st day (C5), then sum the monthly demands from January through December. If the year (C6) is not 1998, the month (C4) is not December, or if it's not the 31st day (C5) then enter "" (i.e., leave the cell blank).

A macro will be added after all four of the areas (i.e., Daily Demand, Monthly Demand, Annual Demand, and Six Month Moving Average) are in place and the formulas have been checked for accuracy. Adding the macro is the last procedure done when constructing this model. This feature reduces the daily effort on this model to three manual entries and two keystrokes. It is best to perform a "winding" pattern starting in the "Daily Demand" area and then moving to the "Monthly Demand" area, the "Six Month Moving Averages" area and finishing in the "Annual Demand" area. The Users Guide in Appendix C provides detailed instructions on the macro's construction. The macro "checks" the formulas hidden behind the gray cell shading and performs the calculations if the arguments are correct. The results are displayed in the non-shaded areas.

Example: Given the formula IF(C4=1,January,"") where (C4) is the month. When cell (C4) =12 and the macro is utilized, it "checks" the formula. It determines that (C4) is currently not equal to 1 and does not enter any data. Now, let cell (C4) =1 and run the macro. It determines that (C4) is currently equal to 1 and enters the month, January.

IV. MODEL SCHEDULE

A. INTRODUCTION

This chapter will focus on the recommended schedule for operation and review of the models. It will also include the number of data entries per model and the time it takes to accomplish the task. An analysis of the models will be performed using NAS Sigonella as the test case.

B. OPERATION

Four of the models developed in this thesis require manual data entry. A recommended schedule for their operation is shown in Figure 4-1.

When	Fuel Type	Model	Number of data entries	Time
Daily	JP5	Daily	5 per tank	23 seconds per tank
			1 per truck	5 seconds per truck
		Issue	# of issues	7 seconds per issue
		Demand	3 per day	15 seconds per day
	Gasoline	Daily	12 per tank	60 seconds per tank
	Diesel	Daily	12 per tank	60 seconds per tank
Receiving Product	JP5 Gasoline Diesel	Receipt	13 per tank	65 seconds per tank

Figure 4-1. Model Operation Schedule.

The Daily Model receives input for all three types of fuel on a daily basis. Gasoline and diesel have twice as many data entries in this model as compared to JP5. It is because they are inventoried two times per day, once at opening (i.e., six entries) and once at closing (i.e., six entries). At the end of the workday, JP5 is inventoried only

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once. The Issue Model keeps track of all the daily JP5 issues by chit number. The number of entries on this model is dependent on the amount of daily activity. The Demand Model has three entries, which are for the month, day, and last two digits of the year. The Receipt Model is utilized sporadically, and only when receiving a shipment of fuel. The data entries in the Receipt Model are identical for all three types of fuel.

The amount of time needed to operate the models can be calculated using the information in Figure 4-1. Example: Naval Air Station Sigonella's fuel farm has nine JP5 storage tanks, ten JP5 fuel trucks, two gasoline storage tanks, and two diesel storage tanks. This fuel farm has an average of thirty-two JP5 issues per day. Manual measurements for all fuel tanks have been collected, and this data is brought to the Recordskeeper. The following information presents how much time it takes to enter the data for an accurate inventory.

Daily Model

9 (JP5 storage tanks) * 23 seconds per tank = 3 minutes 27 seconds.

10 (JP5 fuel trucks) * 5 seconds per truck = 50 seconds.

2 (gasoline storage tanks) * 60 seconds per tank = 2 minutes

2 (diesel storage tanks) * 60 seconds per tank = 2 minutes

Issue Model

32 (JP5 issues per day) * 7 seconds per issue = 3 minutes 44 seconds.

Demand Model

15 seconds per day

Total time per day to operate these models: 12 minutes 16 seconds.

The time it takes to calculate inventory manually at NAS Sigonella is approximately five hours. If errors should occur in these calculations, an additional two to five hours would be added to troubleshoot and research the problem(s). These models can perform all of the manual calculations in 12 minutes 16 seconds. On average, the models would save the Navy close to seven man-hours per day. Furthermore, it would yield a 100% accuracy rate of results at all times. The models also provide a graphical representation of the fuel levels. This feature was not offered with the manual method.

C.   REVIEW

The models that were developed in this thesis provide the Fuels Officer an accurate tool for determining fuel inventory levels, receipt quantities, available storage and tank capacities. They also provide the ability to forecast future fuel ordering needs much more rapidly than the manual methods previously discussed. In order for these models to be effective, the Fuel Officer should review them on a regular cycle. A recommended schedule for their review is shown in Figure 4-2.

When	Models
Daily	Chart
	JP5 Works
	Gas
Monthly	Demand
Prior to ordering	Chart
	Demand
Receiving product	Chart
	Receipts

Figure 4-2. Review Schedule.

V. CONCLUSION

This thesis developed several models that provide the Fuel Officer a quick and accurate tool for determining fuel issues, receipt quantities, fuel inventory levels, available storage and tank capacities. Furthermore, they provide the ability to forecast future fuel ordering needs for Navy fuel farms. Daily, weekly, and monthly usage reports can be generated as needed. The models perform calculations, without errors, in a fraction of the time it takes for manual procedures to be accomplished. Utilizing these models could save approximately seven man-hours of work per day. This reduction in man hours needed is significant enough to warrant the possibility of reducing manning by one person at each fuel farm. This action alone would save the government money.

These models could be used to standardize the Navy's fuel farm recordskeeping inventory procedures at little or no extra cost to the military. Most Navy commands already utilize the Excel™ software, which eliminates the expense of new software. With a continuous change in military personnel every two years, there would be no loss of corporate knowledge if this were the standard throughout the Navy. Necessary training and turnover time would also be greatly reduced.

A Users Guide was developed to familiarize the user with the versatility of Microsoft Excel™ to keep track of fuel inventories. This guide provides step-by-step instructions on how to construct the databases and models as discussed in the thesis.

In summary, this thesis provides a quick accurate fuel inventory system. This system warrants the possibility of standardization throughout the Navy without an increase in government spending. Also, this system is simple, user-friendly and saves time. By reducing man-hours and labor, it also saves the government money. Information can be downloaded and e-mailed to higher commands as needed for strategic planning and allocation usage.

APPENDIX A. STRAPPING CHART FOR "TANK A"

#		#		#		#	
0	6214	1	8040	2	9867	3	11693
4	13520	5	15347	6	17173	7	19000
8	20827	9	22653	10	24480	11	26307
12	28133	13	29960	14	31786	15	33613
16	35440	17	37266	18	39093	19	40920
20	42746	21	44573	22	46400	23	48226
24	50053	25	51880	26	53706	27	55533
28	57359	29	59186	30	61013	31	62839
32	64666	33	66493	34	68319	35	70146
36	71973	37	73799	38	75626	39	77452
40	79279	41	81106	42	82932	43	84759
44	86586	45	88412	46	90239	47	92066
48	93892	49	95719	50	97546	51	99372
52	101199	53	103025	54	104852	55	106679
56	108505	57	110332	58	112159	59	113985
60	115812	61	117639	62	119465	63	121292
64	123118	65	124945	66	126772	67	128598
68	130425	69	132252	70	134078	71	135905
72	137732	73	139558	74	141385	75	143212
76	145038	77	146865	78	148691	79	150518
80	152345	81	154171	82	155998	83	157825
84	159651	85	161478	86	163305	87	165131
88	166958	89	168784	90	170611	91	172438
92	174264	93	176091	94	177918	95	179744
96	181571	97	183398	98	185224	99	187051

#		#		#		#	
0	188878	1	190704	2	192531	3	194357
4	196184	5	198011	6	199837	7	201664
8	203491	9	205317	10	207144	11	208971
12	210797	13	212624	14	214450	15	216277
16	218104	17	219930	18	221757	19	223584
20	225410	21	227237	22	229064	23	230890
24	232717	25	234544	26	236370	27	238197
28	240023	29	241850	30	243677	31	245503
32	247330	33	249157	34	250983	35	252810
36	254637	37	256463	38	258290	39	260116
40	261943	41	263770	42	265596	43	267423
44	269250	45	271076	46	272903	47	274730
48	276556	49	278383	50	280210	51	282036
52	283863	53	285689	54	287516	55	289343
56	291169	57	292996	58	294823	59	296649
60	298476	61	300303	62	302129	63	303956
64	305782	65	307609	66	309436	67	311262
68	313089	69	314916	70	316742	71	318569
72	320396	73	322222	74	324049	75	325876
76	327702	77	329529	78	331355	79	333182
80	335009	81	336835	82	338662	83	340489
84	342315	85	344142	86	345969	87	347795
88	349622	89	351448	90	353275	91	355102
92	356928	93	358755	94	360582	95	362409
96	364234	97	366060	98	367886	99	369712

cm		cm		cm		cm		cm
0	371538	1	373364	2	375190	3	377016	
4	378842	5	380668	6	382494	7	384320	
8	386146	9	387973	10	389799	11	391625	
12	393451	13	395277	14	397103	15	398929	
16	400755	17	402581	18	404407	19	406233	
20	408059	21	409885	22	411711	23	413537	
24	415363	25	417189	26	419015	27	420841	
28	422667	29	424493	30	426319	31	428145	
32	429971	33	431797	34	433623	35	435449	
36	437275	37	439101	38	440927	39	442753	
40	444579	41	446405	42	448231	43	450057	
44	451883	45	453709	46	455535	47	457361	
48	459187	49	461013	50	462839	51	464665	
52	466491	53	468317	54	470143	55	471969	
56	473795	57	475621	58	477447	59	479274	
60	481100	61	482926	62	484752	63	486578	
64	488404	65	490230	66	492056	67	493882	
68	495708	69	497534	70	499360	71	501186	
72	503012	73	504838	74	506664	75	508490	
76	510316	77	512142	78	513968	79	515794	
80	517620	81	519446	82	521272	83	523098	
84	524924	85	526750	86	528576	87	530402	
88	532228	89	534054	90	535880	91	537706	
92	539532	93	541358	94	543184	95	545010	
96	546836	97	548662	98	550488	99	552314	

cm		cm		cm		cm		cm
0	554140	1	555966	2	557792	3	559618	
4	561444	5	563270	6	565096	7	566922	
8	568748	9	570575	10	572401	11	574227	
12	576053	13	577879	14	579705	15	581531	
16	583357	17	585183	18	587009	19	588835	
20	590661	21	592487	22	594313	23	596139	
24	597965	25	599791	26	601617	27	603443	
28	605269	29	607095	30	608921	31	610747	
32	612573	33	614399	34	616225	35	618051	
36	619877	37	621703	38	623529	39	625355	
40	627181	41	629007	42	630833	43	632659	
44	634485	45	636311	46	638137	47	639963	
48	641789	49	643615	50	645441	51	647267	
52	649093	53	650919	54	652745	55	654571	
56	656397	57	658223	58	660049	59	661876	
60	663702	61	665528	62	667354	63	669180	
64	671006	65	672832	66	674658	67	676484	
68	678310	69	680136	70	681962	71	683788	
72	685614	73	687440	74	689266	75	691092	
76	692918	77	694744	78	696570	79	698396	
80	700222	81	702048	82	703874	83	705700	
84	707526	85	709353	86		87		
88		89		90		91		
92		93		94		95		
96		97		98		99		

APPENDIX B. COMPUTER SYSTEM HARDWARE AND SOFTWARE REQUIREMENTS

There are certain minimum levels of computing power and software required to operate the spreadsheets and databases discussed in this thesis.

A. HARDWARE REQUIREMENTS

The spreadsheets and databases discussed in this thesis were designed for use on personal computers. There must be at least one megabyte of memory remaining on the hard drive in order to load both spreadsheet and database files. The size of the database file will vary depending on the number of fuel storage tanks in operation. For this thesis, both files were able to fit and operate on a standard high density 3.5" diskette. This is not the recommended method of operation, however, available computer memory may not be available. The computer must be a 486 or higher processor. The computer must be equipped with a mouse to perform the tasks as described in the user's guide.

B. SOFTWARE REQUIREMENTS

The computer must be running Microsoft Windows 95 operating system at a minimum. All charts, formulas, and macros developed in this thesis were done using Microsoft Excel 97.

APPENDIX C. USER'S GUIDE

A.   INTRODUCTION

The purpose of this guide is to familiarize the user with a way to use the versatility of Microsoft Excel™ to keep track of fuel inventories. Excel™ uses a series of windows and pull down menus. Excel™ is also designed to be very easy to use but does require familiarity with Microsoft Windows and the use of a computer "mouse".

B.   GETTING STARTED

In order to use this Excel™ based model, the user must first open the Excel™ program that meets the compatibility requirements stated in Appendix B. Once Excel™ is open, the user must follow the steps as stated in the guide in order to achieve the desired results.

Throughout this user guide, the following format will be utilized:

Choose File >> Page Setup >> Paper Size >> Landscape.

This format will take the user though the proper progression of steps without having to search for the commands hidden in a paragraph.

It is requested that the user display the following toolbars and view:

1. Standard toolbar.
        Choose View >> Toolbars >> Standard.

2. Formatting toolbar.
        Choose View >> Toolbars >> Formatting.

3. Formula Bar.
        Choose View >> Formula Bar.
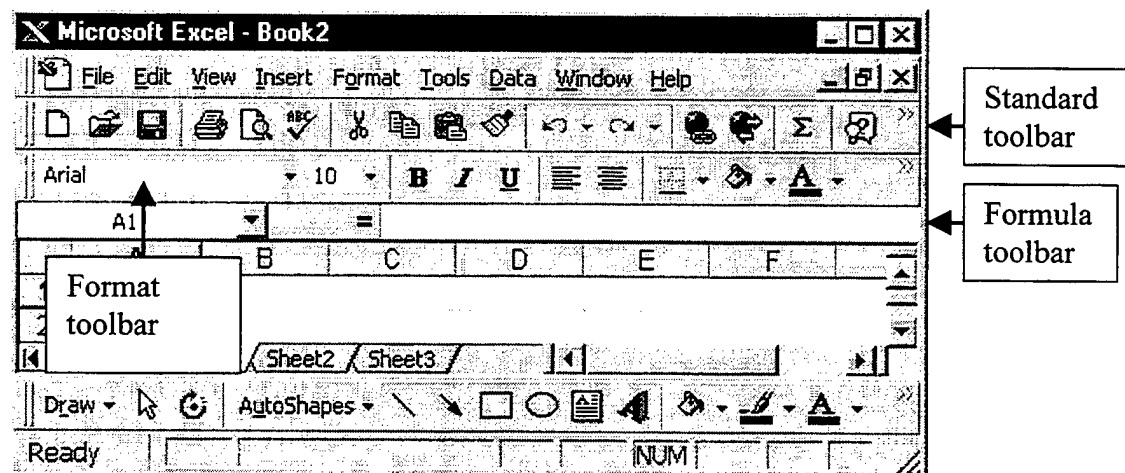
The guide will make reference to shortcuts on the toolbars with the symbol "✗" followed by the command or the symbol displayed on the toolbar (i.e., ✗ Sum or ✗ Σ). Also, the guide will explain a step and may follow it with quotation marks " ". This is to focus the user's attention to a particular word or symbol. If the command is type and then followed by the quotation marks, type the word that is inside the quotation marks, but not the quotation marks. The symbol "↵" is used to represent the keystroke command to return or enter throughout the guide.

C.   DATABASES

This section will cover the construction of the storage tanks, fuel trucks, API Table 5B, and API Table 6B databases. All databases will be created on the same file.

1. Storage Tanks

Looking at the strapping chart in Appendix A, the database needs to be constructed so that it is easy for the user to enter the data, and in a way that Excel™ can efficiently retrieve the data. Start with a new worksheet in Excel™.

a) Name the File "Tanks"

1. Choose File >> Save >> File name: Tanks >> Save.

b) Name the First Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 1". The white cross will turn into a pointer.
2. Double-click. The text portion should darken.
3. Type in the word "Tanks". ↵

c) Entering the Data from the Tank Strapping Charts

1. Select cell A1.
2. Type in the name of the tank. ↵
3. Type in unit of measure (i.e., cm. or in.) in cell A2. ↵
4. Select cell B2.
5. Type in the unit of volume measurement (i.e., gallons or liters). ↵

   Option: Center text in cells A2 and B2. ✕ ☰

6. Select cell A3.
7. Type in the first unit of measurement. All of the strapping charts used in this thesis start with 0 cm. ↵
8. Type in the second unit of measurement (i.e., 1) in cell A4. ↵
9. Highlight (or select) both A3 and A4 cells.
10. On the lower right corner of cell A4 there is a small black square, position the pointer over this. The pointer should change from a thick white cross to a small black cross (i.e., like "+"). This is called the "Auto Fill" handle.

	A	B	C
1	TANK "A"		
2	cm	liters	
3	0		
4	1		
5			

Auto Fill Handle will turn to "+"

11. Drag the Auto fill handle down the column stopping at cell A20. If done correctly, Excel™ has filled in the cells in series (i.e., 1, 2, 3, etc.).

Note: At least two values must be highlighted. This enables Excel™ to know which direction to take the series of numbers. The series for column "A" will be in an ascending order, from top to bottom.

12. With the area A3:A20 still highlighted, go down to the lower right corner of A20 and continue to drag the Auto Fill handle "+" down the column for as many cells as there are entries on the strapping chart for this tank.
13. Now click the mouse anywhere in column B, this takes the user out of Auto Fill mode.

14. Hold down the "Ctrl" and the "Home" keys, or use the scroll bar to return to the top of the worksheet.
15. Position the pointer over cell B3, and click.
16. Type in the volume from the strapping chart that corresponds with the value in cell A3. ↵

Note: Enter data carefully. Try to make data entries without distraction or interruption. All of the future calculations will revolve around the data in these databases.

17. Continue to enter the corresponding volumes down column B.
18. Save work periodically and upon completion, ✂ ▣.
19. Check volume figures. IT IS EXTREMELY IMPORTANT THAT **ALL** OF THE FIGURES ARE CORRECT. Garbage in, garbage out, need I say more?
20. If the interpolation tables are included with the strapping charts then position the pointer over cell D2, and click.
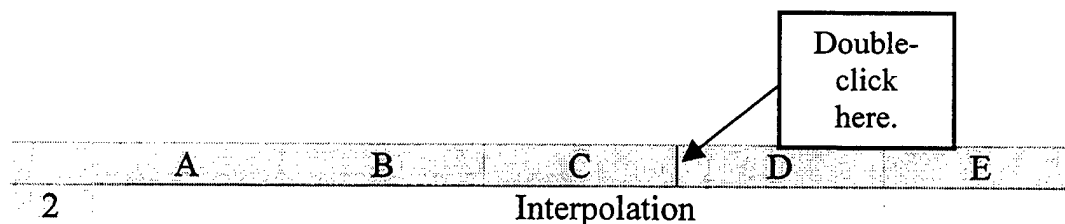
Note: If there are no interpolation tables with the strapping charts then skip to section C.1(e), "Interpolation Table Not Included".

Note: Additional tanks can be added to the same worksheet. It is advisable to start the new tank on the next available column and on row 1. Repeat the procedures found in steps 1 through 20 for the layout. After all of the tanks have been added to the worksheet, write the word "Final" in row 1of the next empty column available. This will mark the end of the columns filled.

d)   Interpolation Table

	Strapping Chart Data			Interpolation Table	
	A	**B**	**C**	**D**	**E**
1	TANK "A"				
2	cm	liters		Interpolation	for <100cm
3	0	6214		mm	liters
4	1	8040		0	0
5	2	9867		1	183
6	3	11693		2	365

1. Type "Interpolation for < " and the scale on the users interpolation table (i.e., 100cm). This should be on row 2 or on the top row of the interpolation table. The Interpolation Table is intentionally lower than the Strapping Chart Data by one row to prevent confusion by making a distinction between the two.

Double-click here.

	A	B	C	D	E
2				Interpolation	

Note: It may be necessary to widen cells to make the words fit. A column can be resized to fit the widest cell entry by double-clicking the right boundary of the column heading.

2. Type in unit of measure (i.e., mm. or $\frac{1}{8}$ in.) in cell D3. This will line up with the first row of numbers in the Strapping Chart Data (i.e., 0 cm and 6214 liters).
3. Select cell E3.
4. Type in the unit of volume measurement (i.e., gallons or liters). ↵

   Option: Center text in cells D3 and E3. ✕ ≡

5. Select cell D4.
6. Type in the first unit of measurement. Because of the formulas used later on, type in "0" for the first unit of measurement. ↵
7. Select cell D5.
8. Type in "1" in cell D5. ↵
9. Highlight cells D4 and D5.

> Another option is to highlight the cells, then: Edit >> Fill >> Series >> Columns >> Linear >> 1 >> OK.

10. Drag the Auto fill handle down the column stopping at cell D14. This is faster than manually entering the series. **Note:** If unit of measure is in $\frac{1}{8}$ inches, then drag Auto fill handle down to cell D12.
11. Click in cell E4.
12. Type in the volume from the strapping chart that corresponds with the value in cell D4. ↵
13. Continue to enter the corresponding volumes down column E.
14. For the second row in the interpolation table, start at D16.

15. Type "Interpolation for < " and the scale on the users interpolation table (i.e., 200cm). This should be the second row of interpolations on the strapping chart.
16. Repeat the procedures found in steps 22 through 32, moving further down columns D and E.
17. Continue steps 34 and 35 for the remainder of the interpolation tables.
18. Save work upon completion, ✕ ◘.

Option: If file size or available memory are not a problem, a blank column can be placed in between the different tank strapping data columns to allow space to keep the information apart. Remember, columns and rows that are left blank that really don't need to be left blank (just to cut down on all that cluttered data), waste computer memory that could otherwise be used to store more information in the worksheet.

Note: Read the "Protection" section after the strapping chart data has been entered for all of the tanks on the fuel farm.

e)   Interpolation Table Not Included

This section gives directions on how to set up the interpolation table if one is not included with the strapping chart.

1. Select cell C2.
2. Type in the word "Interpolation". ↵
3. Type in the number "0" in cell C3. ↵
4. Click cell C4.
5. On the formula bar, below the toolbars, click the equal " = " sign. This tells Excel™ that the user is putting a formula in cell C4.
6. Type an open parenthesis " (".
7. Click cell B5.
8. Type the minus " – " sign.
9. Click cell B4.
10. Type a closed parenthesis ") ".
11. Type a backslash " / ".
12. Type the number "10". ↵

Note: If unit of measure is in inches, type in the number "8" for this step. When the user clicks in cell C4, the <u>formula</u> bar should show the following completed formula: =(B5-B4)/10 and a number is shown in the C4 cell.

13. Click cell C4.
14. On the lower right corner, grab the Auto Fill handle and drag it down the length of the data that is contained in column B. Release when even with the last entry.
15. With the column still highlighted,
   Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK
16. With the column still highlighted, place pointer in the shaded area, "right" click the mouse. This will give the user the option to cut, copy, paste, paste special, etc.
17. Select copy.
18. With the column still highlighted, place pointer in the shaded area "right" click the mouse.
19. Select "paste special" >> values >> none >> OK.
20. Click to any blank cell to un-highlight.

Steps 16 through 19 eliminate the interpolation formula while leaving the value.

21. Save work upon completion, ✕ ▣.

Note: Additional tanks can be added to the same worksheet. It is advisable to start the new tank on the next available column and on row 1. Repeat the procedures found in steps 1 through 37 for the layout. After all of the tanks have been added to the worksheet, write the word "Final" in row 1 of the next empty column available. This will mark the end of the columns filled.

Option: If file size or available memory are not a problem, a blank column can be placed in between the different tank strapping data columns to allow space to keep the information apart. Remember, columns and rows that are left blank that really don't need to be left blank (just to cut down on all that cluttered data), waste computer memory that could otherwise be used to store more information in the worksheet.

Note: Read the "Protection" section after the strapping chart data has been entered for all of the tanks on the fuel farm.
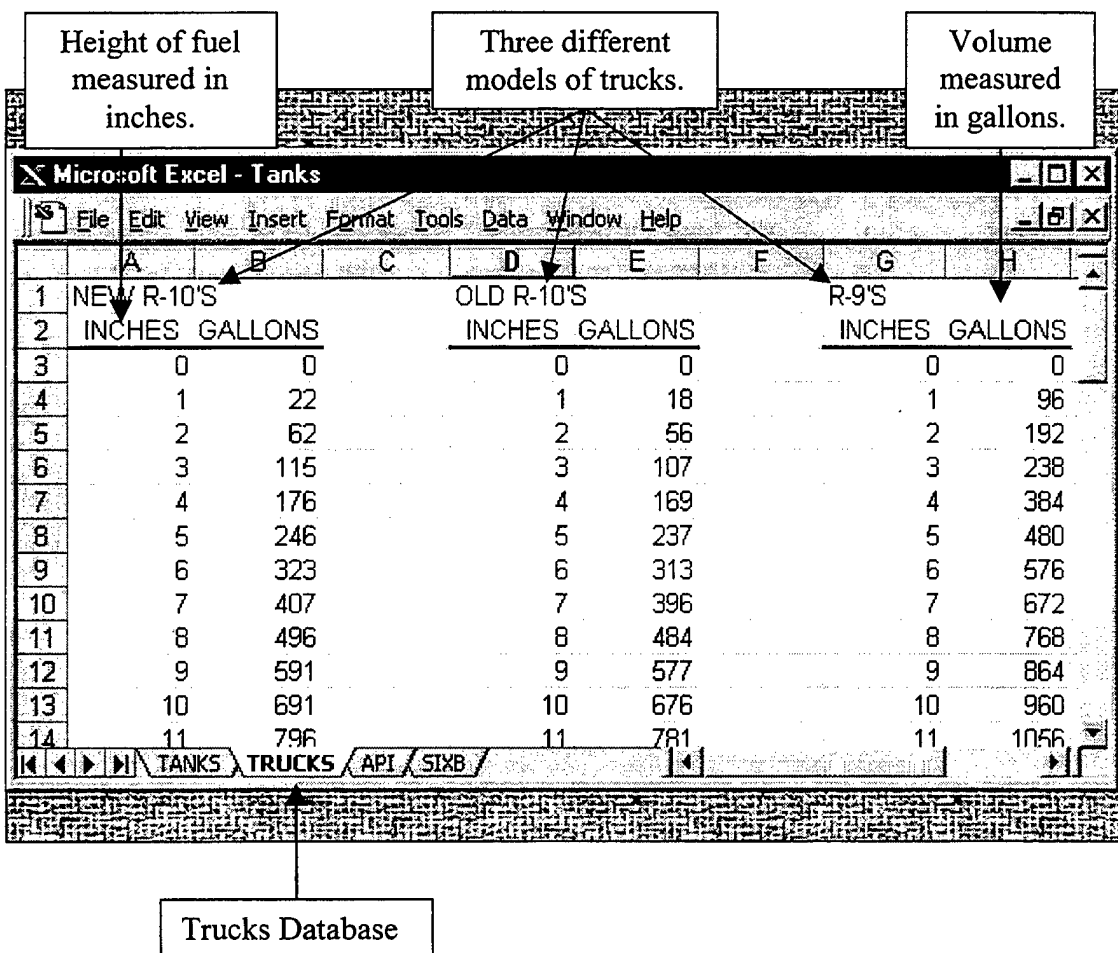
f)   Protection

The purpose of this procedure is to protect the worksheet and turn it into a database after all of the data has been entered and THE FIGURES HAVE BEEN CHECKED FOR CORRECTNESS. This procedure prevents the data from being accidentally changed while viewing or working on the worksheet.

1. With the "Tanks" worksheet displayed.
   Choose Tools >> Protection >> Protect sheet >> Contents, objects, scenarios (all ✓) >> OK.
2. Save ✗ ▣.

Note: The worksheet is now considered a database after being protected.

2. Fuel Trucks

The fuel trucks database is similar in design to the tanks. However, the user will not have to enter vast amounts of data or build an interpolation table. Each model of truck has their own strapping chart. There may be 30 trucks in service (i.e., 10 of one model type and 20 of another.). In this scenario, the user would have two different strapping charts, one for each model. The unit of measurement for the following strapping charts was in inches, and the volume in gallons.

Height of fuel measured in inches.

Three different models of trucks.

Volume measured in gallons.

Microsoft Excel - Tanks

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H
1	NEW R-10'S			OLD R-10'S			R-9'S	
2	INCHES	GALLONS		INCHES	GALLONS		INCHES	GALLONS
3	0	0		0	0		0	0
4	1	22		1	18		1	96
5	2	62		2	56		2	192
6	3	115		3	107		3	238
7	4	176		4	169		4	384
8	5	246		5	237		5	480
9	6	323		6	313		6	576
10	7	407		7	396		7	672
11	8	496		8	484		8	768
12	9	591		9	577		9	864
13	10	691		10	676		10	960
14	11	796		11	781		11	1056

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Trucks Database

a) Name the Second Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked " Sheet 2 ".
2. Double-click. The text portion should darken.
3. Type in the word "Trucks". ↵

b) Entering the Data from the Truck Strapping Charts

1. Select cell A1.
2. Type in the model type of the truck (i.e., R-9, R-10, etc.). ↵
3. Type in unit of measure (i.e., inches) in cell A2. ↵
4. Select cell B2.
5. Type in the unit of volume measurement (i.e., gallons or liters). ↵

   Option: Center text in cells A2 and B2. ✶ ≡

6. Select cell A3.
7. Type in the first unit of measurement. All of the strapping charts used in this thesis started with 0 cm. ↵
8. Type in the second unit of measurement (i.e., 1) in cell A4. ↵
9. Highlight (or select) both A3 and A4 cells.
10. Grab the "Auto Fill" handle on the lower right corner of cell A4.

	A	B	C
1	OLD "R-9"		
2	inches	gallons	
3	0		
4	1		
5			

Auto Fill Handle will turn to "+"

11. Drag the Auto Fill handle "+" down the column for as many cells as there are entries on the strapping chart for this truck model.

Note: When trying to figure the correct number of rows to "drag" the Auto Fill handle, remember to add in the number of rows taken up by the headings. Using the above picture, if there are 52 entries on the trucks strapping chart and 2 rows were taken up for the headings, the user should drag the handle down to row 54.

12. Now click the mouse anywhere in column B, this takes the user out of Auto Fill mode.
13. Hold down the "Ctrl" and the "Home" keys, or use the scroll bar to return to the top of the worksheet.
14. Position the pointer over cell B3, and click.
15. Type in the volume from the strapping chart that corresponds with the value in cell A3. ↵
16. Continue to enter the corresponding volumes down column B.
17. Save work periodically and upon completion, ✂ ▊.
18. Check volume figures. IT IS EXTREMELY IMPORTANT THAT **ALL** OF THE FIGURES ARE CORRECT.

Note: Read the "Protection" section after the strapping chart data has been entered for all of the fuel trucks on the fuel farm.

3. API Table 5B

As stated in Chapter 2 of the thesis, the user should find the normal range of fuel temperatures and API's experienced throughout the year. This will be the "range" of data that will be entered into the Table 5B worksheet/database.

Comparison Column

Given Values in these columns.

	A	B	C	D	E	F	G	H	
1	JP-5		Corresponding API gravity at 60 degrees.						
2	Temp	43.0	43.1	43.2	43.3	43.4	43.5		
3	60.0	43.0	43.1	43.2	43.3	43.4	43.5		
4	60.5			43.2	43.3	43.4	43.5	43.6	
5	61.0			43.1	43.2	43.3	43.4	43.5	
6	61.5	42.9	43.0	43.1	43.2	43.3	43.4	43.5	
7	62.0	42.8	42.9	43.0	43.1	43.2	43.3	43.4	
8	62.5	42.8	42.9	43.0	43.1	43.2	43.3	43.4	
9	63.0	42.7	42.6	42.5	42.4	42.3	42.2	42.5	
10	63.5	42.7	42.6	42.5	42.4	42.3	42.2	42.5	
11	64.0	42.7	42.6	42.5	42.4	42.3	42.2	42.5	
12	64.5	42.6	42.7	42.8	42.9	43.0	43.1	43.2	
13	65.0	42.6	42.7	42.8	42.9	43.0	43.1	43.2	
14	65.5	42.5	42.6	42.7	42.8	42.9	43.0	43.1	

Header Row

Type of fuel.

TANKS / TRUCKS \ API / SIXB /

API 5B Database

Interpolated Values in these four columns.

a) Name the Third Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 3".
2. Double-click. The text portion should darken.
3. Type in the word "API". ↵

b)   Data Entry from the Petroleum Measurement Tables

1.   Select cell A1.
2.   Type in the type of fuel (i.e., JP5, Diesel, MOGAS).   ↵
3.   Type in the word "Temp" in cell A2.   ↵
4.   Click in cell C1.
5.   Type in the words "Corresponding API gravity at 60 F".   ↵
6.   Click in cell A3.
7.   Type the lowest temperature in the range.   ↵

Note: If the lowest temperature in the range is not a whole degree, round it <u>down</u> to the next whole degree (i.e., 59.7° becomes 59.0°).

8.   Click in cell A4.
9.   Take the value from cell A3 and add 0.5. Type this number in cell A4 (i.e., A3 + 0.5 = 59.0 + 0.5 = 59.5).   ↵
10. Highlight (or select) both A3 and A4 cells.

11. Go down to the lower right corner of cell A4, drag the Auto Fill handle "+" down the column for as many cells as there are entries in the range of annual fuel temperatures.

Note: When trying to figure the correct number of rows to "drag" the Auto Fill handle, remember to add in the number of rows taken up by the headings (in this case two) to the number of rows occupied by the range of temperatures. The following formula will help determine the number of rows that will be used by the range of temperatures: ① Highest temperature in range rounded <u>up</u> to next highest whole temperature, minus, lowest temperature in range rounded <u>down</u> to the next whole degree. ② Take this difference and multiply it by two. ③ Now add one to this product for the number of rows needed for the range. Example: Temperature range 59.2 to 75.3. Using the formula, ① 59.0 − 76.0 = 17. ② 17 X 2 = 34 ③ 34 + 1 = 35 rows for temperature + 2 rows for heading = 37 total. Therefore, in this case, the user would drag the handle down to row 37 and release.

12. With the column still highlighted, Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK

Note: Row "A" will also be referred to as the "Comparison Column" throughout the rest of this guide. The numbers in this row are used for reference only.

13. Now click the mouse anywhere in column B, this takes the user out of Auto Fill mode.
14. Hold down the "Ctrl" and the "Home" keys, or use the scroll bar to return to the top of the worksheet.
15. Position the pointer over cell B2, and click.
16. Type in the lowest API in the range, rounded <u>down</u> to the next lowest whole API. ↵

Note: For this database, the interpolated increments of API are in tenths.

17. Position the pointer over cell C2, and click.
18. Take the value from cell B2 and add 0.1. Type this number in cell C2 (i.e., 43.0 + 0.1 = 43.1). ↵
19. Highlight (or select) both B2 and C2 cells.
20. With B2 and C2 still highlighted,
    Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK
21. With B2 and C2 still highlighted, bold the numbers. ✕ **B**

22. Go down to the lower right corner of cell C2, drag the Auto Fill handle "+" to the right, across the row, for as many cells as there are entries in the range of annual API's.

	A	B	C	D
1	JP5			
2	Temp	**43.0**	**43.1**	Drag handle this direction →
3	60.0			
4	60.5			
5	61.0			

Auto Fill Handle will turn to "+"

23. When the user has reached the desired range of API's, click on any row other than row 2 to release the Auto Fill. This row will be referred to as the "Header Row" throughout the rest of this guide. The numbers in this row are used for reference only.
24. Click on the first blank cell available in the same row as the Header Row. Write the word "Final". This will mark the end of the API reference numbers.
25. Click on cell B3.
26. Enter the value from Table 5B, Reference 7, that corresponds to the temperature in cell A3 and the API in cell B2.
27. Continue down column B entering the corresponding values.
28. Save work, ✕ ■.

Note: Table 5B in Reference 7 uses 0.5° F and 0.5° API as the increments for determining API gravity at 60° F.

29. Click on cell B3.
30. Choose Window >> Split
    This should have isolated all the values of column A on the left, and all of the values of row 2 on the top.
31. Using the bottom right scroll bar arrow " ▶ ", click on it until column G appears next to column A.
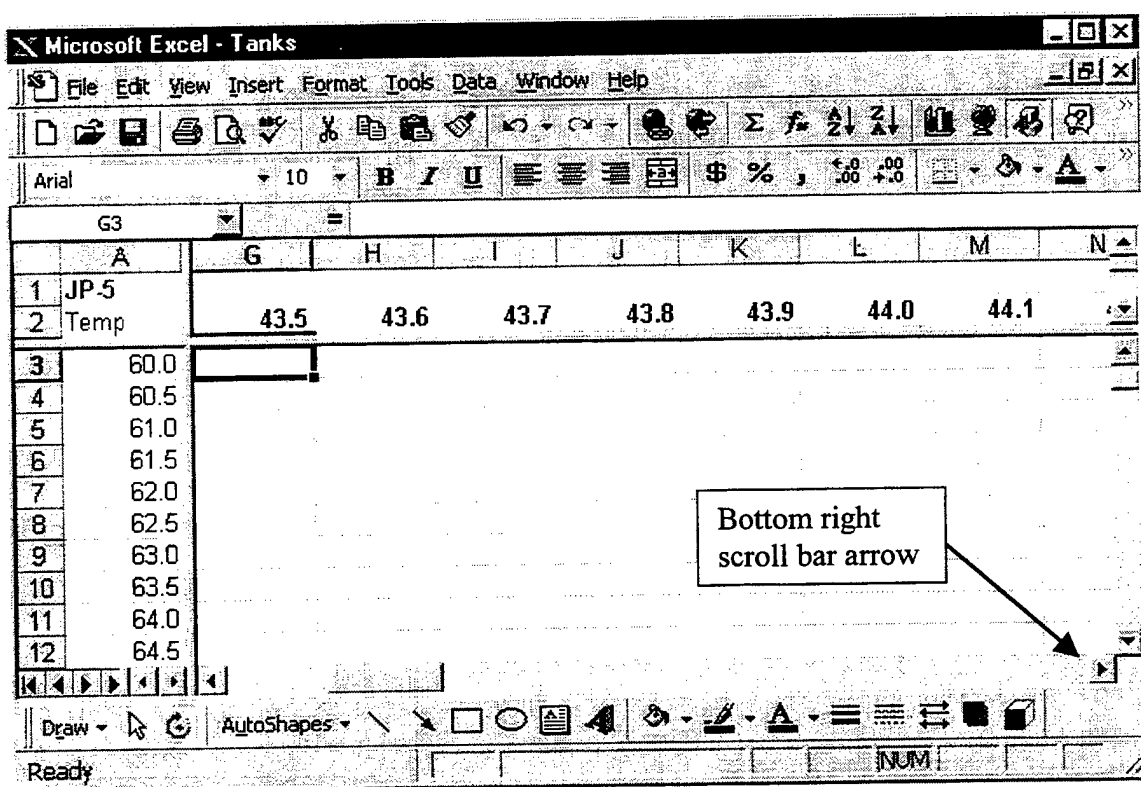
32. Click on cell G3, this should be under a number that ends in .5.
33. Enter the value from Table 5B, Reference 7, that corresponds to the temperature in cell A3 and the API in cell G2.
34. Continue down column G entering the corresponding values.
35. Save work, ✂ ▣.
36. Continue repeating the procedures found in steps 29 through 33 for columns L, Q, V, AA, AF and every fifth column on until the user reaches the end of the API range. Example: Each column represents a 0.1 interpolation, and the reference data is given in 0.5 increments. Therefore, 5 columns * 0.1 interpolation/column = 0.5, same as the reference data. Remember, for these steps, the user should be entering data under columns that are a whole number

(i.e., 43.0) or a half number (i.e., 43.5). The values in these columns will be referred to throughout the rest of this guide as the "given values", meaning these values are straight from Reference 7.

37. Check API figures. IT IS EXTREMELY IMPORTANT THAT **ALL** OF THE FIGURES ARE CORRECT.
38. Choose Window >> Remove Split.
39. Click on cell C3.
40. Click in the formula bar.

Note: The following steps perform interpolation between the "given values". These formulas are easier to type with the "Caps Lock" key on.

41. Type in the formula " =B3+1*(G3-B3)/5 ". ↵
42. Click on cell D3.
43. Click in the formula bar.
44. Type in the formula " =B3+2*(G3-B3)/5 ". ↵
45. Click on cell E3.
46. Click in the formula bar.
47. Type in the formula " =B3+3*(G3-B3)/5 ". ↵
48. Click on cell F3.
49. Click in the formula bar.
50. Type in the formula " =B3+4*(G3-B3)/5 ". ↵

Note: User should have noticed that only one number changed each time the formula was written in a new cell. The one number that changed represented the column position in relation to the two "given" Table 5B values.

left "given value"   right "given value"

COLUMN	B	C	D	E	F	G
POSITION	0	1	2	3	4	5

For the next set.

COLUMN	G	H	I	J	K	L
POSITION	0	1	2	3	4	5

The formula used for interpolation can be described as follows:
= left "given value" + column position*(right "given value" − left "given value")/5

51. Click on cell H3.
52. Click in the formula bar.
53. Type in the formula " =G3+1*(L3-G3)/5 ". ↵

54. Click on cell I3.
55. Click in the formula bar.
56. Type in the formula " = G3+2*(L3-G3)/5 ".↵
57. Click on cell J3.
58. Click in the formula bar.
59. Type in the formula " = G3+3*(L3-G3)/5 ".↵
60. Click on cell K3.
61. Click in the formula bar.
62. Type in the formula " = G3+4*(L3-G3)/5 ".↵
63. Save work, ✂ ▣.
64. Continue to the right, repeating the formula for all the blank columns found in between the "given values".
65. Save work periodically and upon completion, ✂ ▣.
66. Highlight cells C3 through F3.
67. Choose Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK.
68. With cells C3 through F3 still highlighted, place the pointer over the Auto Fill handle until it turns into to "+", drag the handle down the length of the column, stopping when even with the last value in the "given values" columns.
69. Click anywhere in column G to release Auto Fill.
70. Save work, ✂ ▣.
71. Repeat the procedures found in steps 64 through 68 for cells H3 through K3 and the remainder of cells in row 3 within the range. This will fill out the balance of data entries needed for this worksheet.
72. With the "API" worksheet displayed.
    Choose Tools >> Protection >> Protect sheet >> OK.
73. Save ✂ ▣.

Note: The API worksheet is now considered a database after being protected.

4. API Table 6B

This databases design is similar in appearance to the API Table 5B database, although the method of interpolation is different. The normal range of fuel temperatures and API's experienced throughout the year is the "range" of data that is entered into the Table 6B worksheet/database. "Given values" will make reference to exact values straight from Reference 7. "Given values" are in whole numbers (i.e., 60.0° F or 43.0° API) or in half numbers (i.e., 60.5° F or 43.5° API).

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Microsoft Excel - Tanks

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H
1	JP-5		Factor for correcting volume to 60 degrees.					
2	Temp	43.0	43.1	43.2	43.3	43.4	43.5	Header Row
3	60.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	
4	60.5	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
5	61.0	0.99 Type of fuel.		0.9995	0.9995	0.9995	0.9995	0.9995
6	61.5	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992
7	62.0	0.9990	0.9990	0.9990	0.9990	0.9990	0.9990	0.9990
8	62.5	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987
9	63.0	0.9985	0.9985	0.9985	0.9985	0.9985	0.9985	0.9985
10	63.5	0.9982	0.9982	0.9982	0.9982	0.9982	0.9982	0.9982
11	64.0	0.9980	0.9980	0.9980	0.9980	0.9980	0.9980	0.9980
12	64.5	0.9977	0.9977	0.9977	0.9977	0.9977	0.9977	0.9977
13	65.0	0.9975	0.9975	0.9975	0.9975	0.9975	0.9975	0.9975
14	65.5	0.9972	0.9972	0.9972	0.9972	0.9972	0.9972	0.9972

TANKS / TRUCKS / API / SIXB /

SIXB
Database

Interpolated Values in
these four columns.

a)   Create and Name the Fourth Worksheet

1. With the API database open, choose Insert >> Worksheet.
   A new tab called "Sheet 4" will appear at the bottom.
2. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 4".
3. Double-click. The text portion should darken.
4. Type in the word "SIXB ".   ⏎
5. Choose Edit >> Move or Copy Sheet >> Move to end >> OK.

b) Data Entry from the Petroleum Measurement Tables

1. Select cell A1.
2. Type in the type of fuel (i.e., JP5, Diesel, MOGAS). ↵
3. Type in the word "Temp" in cell A2. ↵
4. Click in cell C1.
5. Type in the words "Factor for correcting volume to 60 F". ↵
6. Click in cell A3.
7. Type the lowest temperature in the range. ↵

Note: If the lowest temperature in the range is not a whole degree, round it <u>down</u> to the next whole degree (i.e., 59.7° becomes 59.0°).

8. Take the value from cell A3 and add 0.5. Type this number in cell A4 (i.e., 59.0 + 0.5 = 59.5)
9. Highlight (or select) both A3 and A4 cells.
10. Go down to the lower right corner of cell A4, drag the Auto Fill handle "+" down the column for as many cells as there are entries in the range of annual fuel temperatures.

Note: When trying to figure the correct number of rows to "drag" the Auto Fill handle, remember to add in the number of rows taken up by the headings (in this case two) to the number of rows occupied by the range of temperatures. The following formula will help determine the number of rows that will be used by the range of temperatures: ① Highest temperature in range rounded <u>up</u> to next highest whole temperature, minus, lowest temperature in range rounded <u>down</u> to the next whole degree. ② Take this difference and multiply it by two. ③ Now add one to this product for the number of rows needed for the range. Example: Temperature range 59.2 to 75.3. Using the formula ① 59.0 − 76.0 = 17. ② 17 X 2 = 34 ③ 34 + 1 = 35 rows for temp. + 2 rows for heading = 37 total. Therefore, in this case, the user would drag the handle down to row 37.

11. With the column still highlighted,
    Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK
12. Now, click the mouse anywhere in column B. This takes the user out of Auto Fill mode.
13. Hold down the "Ctrl" and the "Home" keys, or use the scroll bar to return to the top of the worksheet.
14. Position the pointer over cell B2, and click.

15. Type in the lowest API in the range, rounded <u>down</u> to the next lowest whole API. ↵

Note: For this database, the interpolated increments of API are in tenths.

16. Position the pointer over cell C2, and click.
17. Take the value from cell B2 and add 0.1. Type this number in cell C2 (i.e., 43.0 + 0.1 = 43.1). ↵
18. Highlight (or select) both B2 and C2 cells.
19. With B2 and C2 still highlighted,
    Format >> Cells >> Number >> Number >> Decimal places: 1 >> OK
20. With B2 and C2 still highlighted, bold the numbers. ⌘ **B**

21. Go down to the lower right corner of cell C2, drag the Auto Fill handle "+" to the right, across the row, for as many cells as there are entries in the range of annual API's.

	A	B	C	D
1	JP5			
2	Temp	**43.0**	**43.1**	Drag handle → this direction
3		60.0		
4		60.5		
5		61.0		

Auto Fill Handle will turn to "+"
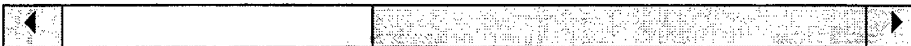
22. When the user has reached the desired range of API's, click on any row other than row 2 to release the Auto Fill.
23. Click on the first blank cell available in the same row as the Header Row. Write the word "Final". This will mark the end of the API reference numbers.
24. Click on cell B3, this should be under a number that ends in .0.
25. Highlight down column B, stopping when even with the last temperature in column A.
26. Choose Format >> Cells >> Number >> Number >> Decimal places: 4 >> OK
27. Click anywhere on worksheet to release highlight.
28. Click on cell B3.
29. Enter the value from Table 6B, Reference 7, that corresponds to the temperature in cell A3 and the API in cell B2. ↵
30. Continue down column B entering the corresponding values.
31. Save work, ⌘ ▤.
32. Click on cell B3.

33. Choose Window >> Split
This should have isolated all the values of column A on the left, and all of the values of row 2 on the top.
34. Using the bottom right scroll bar arrow " ▶ ", click on it until column G appears to be next to column A.

	A	G	H	I
1	JP5			
2	Temp	43.5	43.6	43.7
3	60.0			
4	60.5			
5	61.0			

Bottom right scroll bar arrow ↗

35. Click on cell G3, this should be under a number that ends in .5.
36. Highlight down column G, stopping when even with the last temperature in column A.
37. Choose Format >> Cells >> Number >> Number >> Decimal places: 4 >> OK
38. Click anywhere on worksheet to release highlight.
39. Click on cell G3.
40. Enter the value from Table 6B, Reference 7, that correspond to the temperature in cell A3 and the API in cell G2.
41. Continue down column G entering the corresponding values.
42. Save work, ✸ ◘.
43. Continue repeating the procedures found in steps 23 through 30 and 33 through 41 for columns L, Q, V, AA, AF and so on until the user reaches the end of the API range. Remember, for these steps, the user should be entering data under columns that are a whole number (i.e., 43.0) or a half number (i.e., 43.5). These are the "given values" as mentioned above.
44. Check API figures. IT IS EXTREMELY IMPORTANT THAT **ALL** OF THE FIGURES ARE CORRECT.
45. Choose Window >> Remove Split.
46. Save work, ✸ ◘.
47. Click cell B3.
48. Highlight from cell B3 down to the last entry in column B.

Note: IMPORTANT! Do not "drag" the handle from cell B3 down! All data entries in column B will be lost except for cell B3, which would be copied as far as the handle was taken. If user "dragged" by accident, go to the

toolbar and press the "undo" button. Another option is to choose Edit >> Undo. Another option is to press the "Ctrl" and "z" keys at the same time. One last option is to close the window and press the "No" button when asked if the user wants to save the changes. If using this option, the user should retrace their steps to the last "save" and start from there.

49. With the column still highlighted, on the last cell, user should see the little black box on the lower right corner.

	A	B	C	D	E
39	78.0	0.9909			
40	78.5	0.9907			
41	79.0	0.9904			
42	79.5	0.9902			
43	80.0	0.9899			

Auto Fill Handle will turn to "+"

50. Drag the Auto Fill handle "+" to the right, across two columns and release. This should have made an exact copy of column B on columns C and D.

	A	B	C	D	E
39	78.0	0.9909	0.9909	0.9909	
40	78.5	0.9907	0.9907	0.9907	
41	79.0	0.9904	0.9904	0.9904	
42	79.5	0.9902	0.9902	0.9902	
43	80.0	0.9899	0.9899	0.9899	

51. Click anywhere on the worksheet to release the Auto Fill.
52. Click cell G3.
53. Highlight from cell G3 down to the last entry in column G.
54. With the column still highlighted, on the last cell, user should see the little black box on the lower right corner.

55. Drag the Auto Fill handle "+" to the left, across two columns and release. This should have made an exact copy of column G on columns E and F.

56. With columns E, F, and G still highlighted, drag the Auto Fill handle "+" to the right, across two columns and release. This should have made an exact copy of column G on columns H and I. Columns E through I should be identical.

57. Save work, �由 ■.
58. Click cell L3.

59. Repeating the procedures found in steps 52 through 56. Columns J though N should be identical.
60. Continue repeating the procedures found in steps 52 through 56 until all columns "in range" have been filled.
61. With the "SIXB" worksheet displayed.
    Choose Tools >> Protection >> Protect sheet >> OK.
62. Save work, �винку ■.

Note: The SIXB worksheet is now considered a database after being protected. This completes the database portion of the Users' Guide. A copy of the database should stored on a separate floppy disk.

5. Changes, Additions, Deletions

Occasionally revisions need to be performed on the database due to additions or deletions of tanks and trucks. If changes are made to the primary database, remember to update the copy of the database stored on a separate floppy disk.

1. Open the database where the change will be performed (i.e., TANKS, TRUCKS, API, SIXB).
2. Unprotect the database.
   Choose Tools >> Protection >> Unprotect sheet >> OK.

a) Changes

1. Go to cell/area that needs corrections.
2. Make corrections.
3. Double-check work for accuracy (i.e., changed the right cell, is this the right value, etc.).
4. With the changed database displayed.
   Choose Tools >> Protection >> Protect sheet >> OK.
5. Save work, ✖ ■.

b) Additions

1. Go to the top of the database.
2. Scroll to the right until the last column of data is found. Another option is:
   Edit >> Find >> Find what: Final >> Search: By Row >> Find Next.
3. On the next available unoccupied column, click on the cell in row 1.

4. If the addition is a tank, go to section 1 "Storage Tanks" and follow steps 1 though 37. If the addition is a truck, go to section 2 "Fuel Trucks" and follow steps 1 though 18. If the addition is to the API 5B database, go to section 3 "API Table 5B" and follow steps 1 though 71. If the addition is to the API 6B database, go to section 4 "API Table 6B" and follow steps 1 though 61.

Note: Remember to write the word "Final" on the next unoccupied column in the Header Row.

c) Deletions

1. Locate the column to be deleted.
2. Click on the top cell of the column or click on the letter. This highlights the entire column.
3. Hit the "Delete" key on the keyboard. Another option is: choose Edit >> Delete.
4. With the changed database displayed.
   Choose Tools >> Protection >> Protect sheet >> OK.
5. Save work, ✕ ▣.

D. MODELS

This section will cover the construction of the Daily, Issue, Receipt, JP5 Works, JP5 Close, Gas and Demand Models. All of the models will be created on the same file.

1. Daily Model

The Daily Model is an area containing raw data waiting to be processed by the other models. To prevent confusion, the layout of the data fields should be grouped by similar fuel and container type.

Daily Model Tab

a) Name the File "Model"

1. Choose File >> Save >> File name: Model >> Save.

b) Name the First Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 1". The white cross will turn into a pointer.
2. Double-click. The text portion will darken.
3. Type in the word "Daily". ⏎

c) Entering the JP5 Storage Tank Layout

Microsoft Excel - Model						
File Edit View Insert Format Tools Data Window Help						
	A	B	C	D	E	F
1	NAS SIGONELLA FUELS DIVISION					
2	DAILY SOUNDING REPORT					
3						
4	JP5 FUEL					
5	Yesterdays close		450,000.0	gallons		
6						
7	TANK	GAUGE	TEMP	H20	API	TEMP
8		cm	Sample	Cut	Observed	Tank
9	A	85	61	0	45.3	68
10	B	84.6	62	0	45.2	68
11	C	198	60	0	46.0	68
12	3	70.3	62	3	45.4	68
13	4	100	62	0	45.0	70
14	D1	319	70	0	47.0	75
15	D2	232	70	0	47.5	75
16	D3	300.1	69	0	44.9	72
17	D4	222.6	68	0	46.5	73
18						
DAILY / ISSUES / JP5CLOSE / JP5W(						

1. Select cell C1.
2. Type in the name of the command (i.e., NAS Sigonella Fuels Division). ⏎
3. Select cell C1.
4. Choose Font Size Selection >> 14 ⏎
5. Select cell C2.
6. Type in the name of the report (i.e., Daily Sounding Report). ⏎
7. Select cell C2.
8. Choose Font Size Selection >> 14 ⏎
9. Highlight cells C1 and C2.

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10. Center text in cells C1 and C2. ✕ ≡
11. Select cell A4.
12. Type in the name of the fuel (i.e., JP5). ↵
13. Select cell A4.
14. Choose Font Size Selection >> 14
15. Choose Font Color Selection >> Red
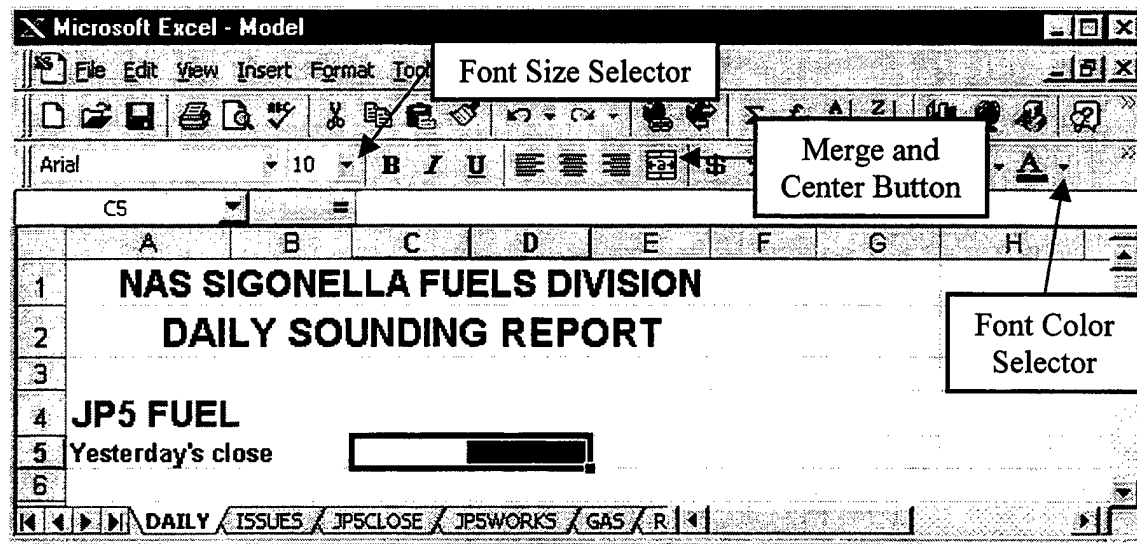
16. Select cell A5.
17. Type in the words "Yesterday's close". ↵
18. Highlight cells C5 and D5.
19. On the Format toolbar, select the "Merge and Center" button.
20. With cells C5 and D5 still highlighted, choose:
    Format >> Cells >> Border (tab) >> Style: select a line of medium thickness. >> Outline >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.

Note: This shaded area is ready to receive the closing JP5 fuel inventory from the day before. This is a manual entry. **A cell that is shaded hereafter will represent a location where a manual data entry is to be made.** Use the same color of cell shading for the manual entry areas in the upcoming models.

21. Select cell E5.
22. Type in the word "gallons". ↵
23. Select cell A7.
24. Type in the word "TANK". ↵
25. Select cell B7.

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26. Type in the word "GAUGE". ↵
27. Select cell B8.
28. Type in the letters "cm". This is the unit of measurement. ↵

Note: This column will represent the uncorrected fuel height measurement.

29. Select cell C7.
30. Type in the word "TEMP". ↵
31. Select cell C8.
32. Type in the word "Sample". ↵

Note: This column will represent the temperature of the sample taken.

33. Select cell D7.
34. Type in the letters "H2O". ↵
35. Select cell D8.
36. Type in the word "Cut". ↵

Note: This column will represent the height of the water in the storage tank.

37. Select cell E7.
38. Type in the letters "API". ↵
39. Select cell E8.
40. Type in the word "Observed". ↵

Note: This column will represent the observed API gravity of the sample.

41. Select cell F7.
42. Type in the word "TEMP". ↵
43. Select cell F8.
44. Type in the word "Tank". ↵

Note: This column will represent the temperature of the fuel in the storage tank.

Note: The column headings in the JP5 Storage Tank layout are complete.

45. Select cell A9.
46. Type in the name or letter of the tank (i.e., A). ↵
47. Highlight cells B9 through F9.
48. Choose
      Format >> Cells >> Number (tab) >> Category: Number >> Decimal
      places: 1 >> Border (tab) >> Style: select a line of medium thickness. >>

Outline >> Inside >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell B9. The sample temperature will be a manual entry in cell C9. The height of the water will be a manual entry in cell D9. The observed API will be a manual entry in cell E9. The tank temperature will be a manual entry in cell F9.

Note: The first tank layout is complete.

49. Select cell A10.
50. Type in the name or letter of the tank (i.e., B).   ↵
51. Highlight cells B10 through F10.
52. Choose
Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> Border (tab) >> Style: select a line of medium thickness. >> Outline >> Inside >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell B10. The sample temperature will be a manual entry in cell C10. The height of the water will be a manual entry in cell D10. The observed API will be a manual entry in cell E10. The tank temperature will be a manual entry in cell F10.
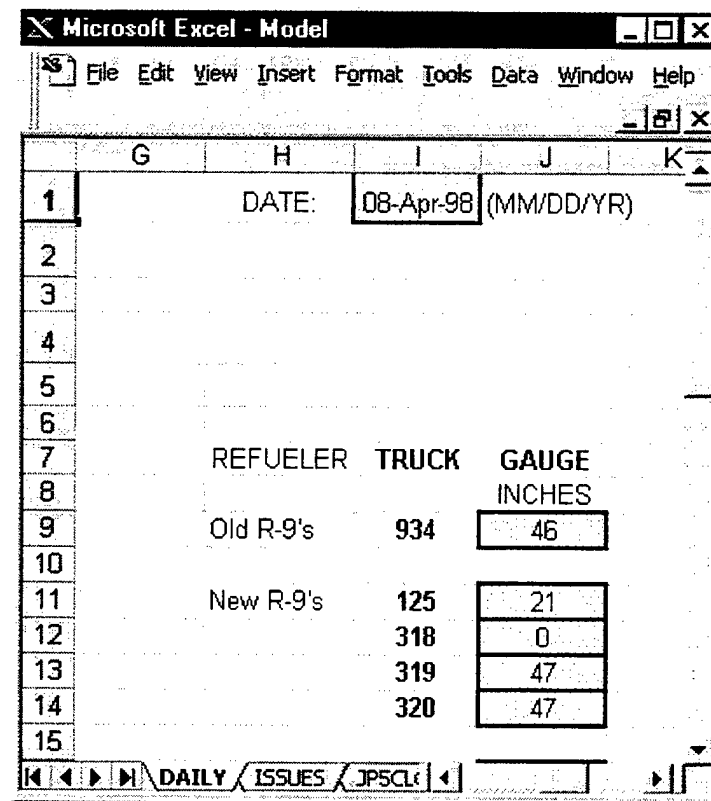
Note: The second tank layout is complete.

53. Continue the procedure in steps 49 though 52 for each of the remaining JP5 storage tanks.
54. Save work upon completion, ✂ ▉.

d) Entering the JP5 Truck Layout

Group the same type of truck models (i.e., old R-9's, new R-10's) together in the JP5 Truck layout.

1. Select cell H1.
2. Type in the word "DATE".   ↵
3. Select cell I1.
4. Choose

    Format >> Cells >> Number (tab) >> Category: Date >> Type: 4-Mar-97
    >> Border (tab) >> Style: select a line of medium thickness. >> Outline >>
    Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select
    the color white. >> OK.

5. Select cell J1.
6. Type in the letters "(MM/DD/YR)".   ↵

Note: This step displays the format for manually entering the date into cell I1.

7. Select cell H7.
8. Type in the word "MODEL" or "REFUELER".   ↵

Note: This column will represent the truck model type.

9. Select cell I7.
10. Type in the word "TRUCK". ↵

Note: This column will represent the truck number.

11. Select cell J7.
12. Type in the word "GAUGE". ↵
13. Select cell J8.
14. Type in the word "Inches". This is the unit of measurement. ↵

Note: This column will represent the measured height of fuel in the truck.

Note: The column headings in the JP5 Truck layout are complete.

15. Select cell H9.
16. Type in the name of the tanks model type (i.e., Old R-9's). ↵
17. Select cell I9.
18. Type in the truck's number (i.e., 934).
19. Select cell J9.
20. Choose
    Format >> Cells >> Number (tab) >> Category: Number >> Decimal
    places: 0 >> Border (tab) >> Style: select a line of medium thickness. >>
    Outline >> Patterns (tab) >> Cell Shading Color: select a light color. >>
    Pattern: select the color white. >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell J9.

Note: The layout for the first truck is complete.

21. Continue the procedure in steps 15 though 20 for each of the remaining JP5
    trucks that are the same model type.

Note: The user has the option to skip a row in between the different truck model
    types.

22. Save work upon completion, �֍ ▤.

e)   Entering the Gas Station Layout

There are two parts to the Gas Station layout: the opening and the closing inventories. Only one gasoline and one diesel tank will be described for this layout.

Opening Inventory | Closing Inventory

	A	B	C	D	E	F	G	H	I	J	K	L	M
23	GAS STATION												
24		OPENING INVENTORY						CLOSING INVENTORY					
25	GASOLINE	GAUGE	TEMP	H20	API	TEMP	METER	GAUGE	TEMP	H20	API	TEMP	METER
26	Tank	cm	Sample	CUT	Observed	Tank		cm	Sample	CUT	Observed	Tank	
27	MG1	109	68	0	63.3	64	1379203	180	76	0	62.5	76	1379203
28	MG2	58	68	4.5	63.2	83	1932816	145.7	76	3	62.4	76	1936453
29	DIESEL												
30	DFM	225	73	8	40.3	64	1739928	219.8	78	3	40	78	1751956
31	TNK 10	115.5	68	0	40.5	63	2866607	115.5	78	0	40.4	78	2866607

DAILY / ISSUES / JPSCLOSE / JPSWORKS / GAS / ReceiptA / ReceiptB

(1)   Opening Gasoline Inventory

1. Select cell A23.
2. Type in the words "GAS STATION".   ↵
3. Select cell A23.
4. Choose Font Size Selection >> 14   ↵
5. Select cell B24.
6. Type in the words "OPENING INVENTORY".   ↵
7. Select cell B24.
8. Choose Font Size Selection >> 12   ↵
9. Select cell A25.
10. Type in the word "GASOLINE".   ↵
11. Select cell A25.
12. Choose Font Size Selection >> 12   ↵
13. Select cell A26.
14. Type in the word "Tank".   ↵

Note: This column will represent the names of the gasoline tanks.

15. Select cell B25.
16. Type in the word "GAUGE".   ↵
17. Select cell B26.
18. Type in the letters "cm".   ↵

Note: This column will represent the uncorrected fuel height measurement.

19. Select cell C25.
20. Type in the word "TEMP". ↵
21. Select cell C26.
22. Type in the word "Sample". ↵

Note: This column will represent the temperature of the sample taken.

23. Select cell D25.
24. Type in the letters "H2O". ↵
25. Select cell D26.
26. Type in the word "Cut". ↵

Note: This column will represent the height of the water in the storage tank.

27. Select cell E25.
28. Type in the letters "API". ↵
29. Select cell E26.
30. Type in the word "Observed". ↵

Note: This column will represent the observed API gravity of the sample taken.

31. Select cell F25.
32. Type in the word "TEMP". ↵
33. Select cell F26.
34. Type in the word "Tank". ↵

Note: This column will represent the temperature of the fuel in the storage tank.

35. Select cell G25.
36. Type in the word "METER". ↵

Note: The opening column headings are complete.

37. Select cell A27.
38. Type in the name or letter of the tank (i.e., MG1). ↵
39. Highlight cells B27 through G27.
40. Choose
    Format >> Cells >> Border (tab) >> Style: select a line of medium thickness. >> Outline >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.

41. Highlight cells B27 through F27
42. Choose

> Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell B27. The sample temperature will be a manual entry in cell C27. The height of the water will be a manual entry in cell D27. The observed API will be a manual entry in cell E27. The tank temperature will be a manual entry in cell F27. The meter reading will be a manual entry in cell G27.

Note: The Opening Inventory layout for the first tank is complete.

43. Continue the procedure in steps 37 though 42 for each of the remaining gasoline storage tanks.
44. Save work upon completion, � ▪.

(2)   Closing Gasoline Inventory

1. Select cell H24.
2. Type in the words "CLOSING INVENTORY".   ↵
3. Select cell H24.
4. Choose   Font Size Selection >> 12   ↵
5. Select cell H25.
6. Type in the word "GAUGE".   ↵
7. Select cell H26.
8. Type in the letters "cm".   ↵

Note: This column will represent the uncorrected fuel height measurement.

9. Select cell I25.
10. Type in the word "TEMP".   ↵
11. Select cell I26.
12. Type in the word "Sample".   ↵

Note: This column will represent the temperature of the sample taken.

13. Select cell J25.
14. Type in the letters "H2O".   ↵
15. Select cell J26.
16. Type in the word "Cut".   ↵

Note: This column will represent the height of the water in the storage tank.

17. Select cell K25.
18. Type in the letters "API".   ↵
19. Select cell K26.
20. Type in the word "Observed".   ↵

Note: This column will represent the observed API gravity of the sample taken.

21. Select cell L25.
22. Type in the word "TEMP".   ↵
23. Select cell L26.
24. Type in the word "Tank".   ↵

Note: This column will represent the temperature of the fuel in the storage tank.

25. Select cell M25.
26. Type in the word "METER".   ↵

Note: This column will represent the temperature of the fuel in the storage tank.

Note: The closing column headings are complete.

27. Highlight cells H27 through M27.
28. Choose
     Format >> Cells >> Border (tab) >> Style: select a line of medium
     thickness. >> Outline >> Patterns (tab) >> Cell Shading Color: select a
     light color. >> Pattern: select the color white. >> OK.
29. Highlight cells H27 through L27.
30. Choose
     Format >> Cells >> Number (tab) >> Category: Number >> Decimal
     places: 1 >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell
     H27. The sample temperature will be a manual entry in cell I27. The
     height of the water will be a manual entry in cell J27. The observed API
     will be a manual entry in cell K27. The tank temperature will be a manual
     entry in cell L27. The meter reading will be a manual entry in cell M27.

Note: The Closing Inventory layout portion for the first tank is complete.

Note: The Gas Station Inventory layout for the first tank is also complete.

31. Continue the procedure in steps 27 though 30 for each of the remaining gasoline storage tanks.
32. Save work upon completion, ✂ ▣.

(3)   Opening Diesel Inventory

The column headings from the Opening Gasoline Inventories will be used for the Opening Diesel Inventories.

1. Select cell A29.
2. Type in the word "DIESEL".   ↵
3. Select cell A29.
4. Choose   Font Size Selection >> 12   ↵
5. Select cell A30.
6. Type in the name or letter of the tank (i.e., DFM).   ↵
7. Highlight cells B30 through G30.
8. Choose
   Format >> Cells >> Border (tab) >> Style: select a line of medium thickness. >> Outline >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.
9. Highlight cells B30 through F30.
10. Choose
   Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> OK.

Note: The fuel height measurement will be a manual entry in cell B30.
   The sample temperature will be a manual entry in cell C30.
   The height of the water will be a manual entry in cell D30.
   The observed API will be a manual entry in cell E30.
   The tank temperature will be a manual entry in cell F30.
   The meter reading will be a manual entry in cell G30.

Note: The Opening Inventory layout for the first tank is complete.

11. Continue the procedure in steps 5 though 10 for each of the remaining diesel storage tanks.
12. Save work upon completion, ✂ ▣.

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(4)   Closing Diesel Inventory

The column headings from the Closing Gasoline Inventories will be used for the Closing Diesel Inventories.

1. Highlight cells H30 through M30.
2. Choose
   Format >> Cells >> Border (tab) >> Style: select a line of medium thickness. >> Outline >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.
3. Highlight cells H30 through L30.
4. Choose
   Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> OK.

Note: The fuel height measurement will be a manual entry in cell H30.
The sample temperature will be a manual entry in cell I30.
The height of the water will be a manual entry in cell J30.
The observed API will be a manual entry in cell K30.
The tank temperature will be a manual entry in cell L30.
The meter reading will be a manual entry in cell M30.

Note: The Closing Inventory layout portion for the first diesel tank is complete.

5. Continue the procedure in steps 1 though 4 for each of the remaining diesel storage tanks.
6. Save work upon completion, ✄ ▤.

Note: The Gas Station Inventory layout for the first diesel tank is complete.

f)   Protecting the Model

Upon completion of the Closing Diesel Inventory section, certain areas of the model should be "protected" (i.e., locked) from change. The other areas, namely the manual entries (i.e., shaded cells) should be left unprotected (i.e., unlocked) so that they can be changed.

1.   Highlight the cell range to be unprotected (i.e., unlocked).

Note: The above cell range B9 through F17 has been selected for unprotection (i.e., unlocked).

2. Choose
   Format >> Cells >> Protection (tab) >> Clear the locked and hidden check boxes as shown. >> OK.
3. Repeat steps 1 and 2 for the remaining manual entry cells (i.e., shaded cells) on the model.

Note: All the shaded cells are unlocked.

4. Choose
   Tools >> Protection >> Protect sheet >> Contents, objects, scenarios (all ✓) >> OK.
5. Save ✗ ■.

Note: The model is now protected.

Note: After the model has been protected, the cells that were unlocked in this procedure are the only cells that can be changed. This procedure ensures protected data is safe from any accidental changes while viewing or working on the model.

2. Issue Model

The header row on the Issue Model will be different for each Naval Station. The categories displayed here are for illustrative purposes only. The customers that are issued to on a regular basis should be placed on the header row. Even though Excel™ will accommodate 256 categories (i.e., columns), it is recommended to make this model a one-page printout (smaller pitch (i.e., font size) and abbreviated titles will help to fit more columns on one page).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	JP5 ISSUE SHEET										Date:	08-Apr-98	
2													
3	CHIT NUM	A/C TYPE	HC4	PA S			USN TRAN	USMC TRAN	USA TRAN	USAF TRAN	FOR'N TRAN	NON DOD	DEFUEL
4	185	C-9								2185			
5	184	P-3		1467									
6	118	C-17								4648			
7	116	H-53	253										
8	51	VR-61					3728						
9	50	H-53	485										
10	49	H-53	819										
11	48	NETH									2931		
12	46	ATA										1865	
13	42	P-3		3007									
14	41	H-53	1233										
15	27	C-130								2207			
16	26	P-3											
17	23	C-141								2704			
18	20	C-141								1349			
19	19	C-141								2600			
20	17	VR-61											100
21	14	P-3			672								
22	12	P-3			2976								
23	11	VR-55					1738						
24													
25		TOTALS	2790	4474	3648	0	5466	0	0	15693	2931	1865	100
26													
27	TOTAL ISSUES:	36867	gallons								DEFUEL:	100	

Header Row

Issue Model Tab

CHART / DAILY \ ISSUES \ JP5CL

a) Name the Second Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 2". The white cross will turn into a pointer.
2. Double-click. The text portion will darken.
3. Type in the word "Issue". ↵

b) Entering the Issue Model Layout

1. Select cell A1.
2. Type in the words "JP5 ISSUE SHEET". ↵
3. Select cell A1.
4. Choose Font Size Selection >> 16 ↵
5. Select cell L1.
6. Type in the word "Date:". ↵
7. Select cell M1.
8. On the formula bar, below the toolbars, click the " = " sign. This tells Excel™ that the user is inserting a formula in or linking data from another model to cell M1.
9. Click the Daily Model tab located to the left of the Issue Model tab.

Note: " =DAILY! " will be displayed in the formula bar.

10. Select cell I1 (i.e., the shaded manual entry date cell).

Note: " =DAILY!I1 " will be displayed in the formula bar.

11. Click on OK.

Note: Steps 7 through 11 will be referred to as "**linking**" to another model.

Note: A number will then be displayed in cell I1 (e.g., 35893).

12. With cell I1 still selected, choose:
    Format >> Cells >> Number (tab) >> Category: Date >> Type: 04-Mar-97 >> OK.
13. With cell I1 still selected, choose: Font Size Selection >> 8
14. Select cell A3.
15. Type in the word "CHIT".

	A	B	C	D	E	F	G	
2								
3	CHIT							
4								

Microsoft Excel - Model
File Edit View Insert Format Tools Data Window Help
A3   = CHIT
DAILY \ ISSUES / JP5CLOSE /
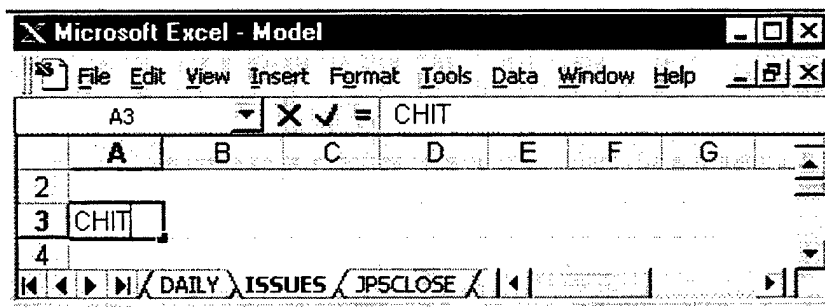
16. With the cursor still blinking in cell A3, press the keys "Alt" and "Enter" simultaneously.
17. Type in the word "NUM". ↵

Note: Pressing the "Alt" and "Enter" keys simultaneously alerts Excel™ that the user wants to start the next sentence within the same cell. This function will wrap text within the same cell. Excel™ recognizes only one row as the Header Row. This Header Row will become important in the section on sorting.

18. Select cell B3.
19. Type in the letters "A/C".
20. With the cursor still blinking in cell B3, press the "Alt" and "Enter" keys simultaneously.
21. Type in the word "TYPE". ↵
22. Highlight cells A3 and B3.
23. Center text in cells A3 and B3. ✂ ≣

Note: The number of categories in the Header Row will be at the user's discretion.

24. Highlight the entire Header Row.
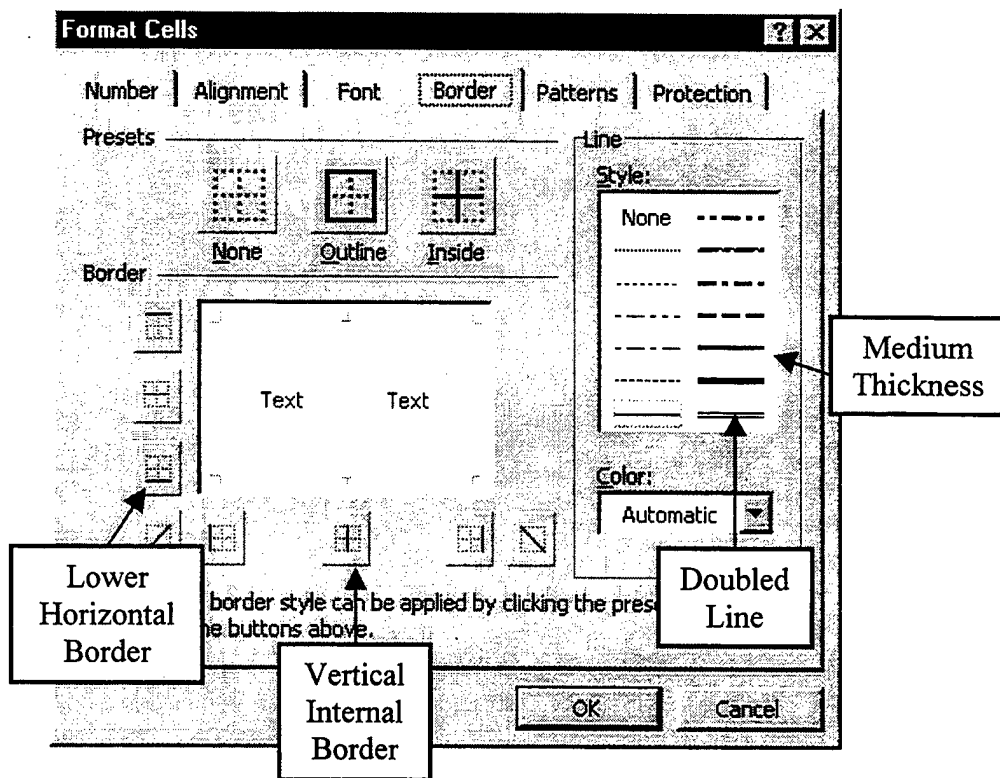
25. Choose

    Format >> Cells >> Border (tab) >> Style: select a doubled line. >> Outline >> Style: select a dashed line. >> Select the vertical internal border >> OK.

26. Select cell A4.

27. Starting with column A, highlight rows 4 and 5 to the right until the last category in the Header Row has been reached.

28. With this range still highlighted, choose:

    Format >> Cells >> Border (tab) >> Style: select a medium thickness line. >> Inside >> Style: select a thick line. >> Select the lower horizontal border >> OK.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	JP5 ISSUE SHEET											Date:	08-Apr-98
2													
3	CHIT NUM	A/C TYPE	HC4	PATR'N SIG	AIMD	OMD	USN TRAN	USMC TRAN	USA TRAN	USAF TRAN	FOR'N TRAN	NON DOD	DEFUEL
4													
5													
6		TOTALS	0	0	0	0	0				0	0	0
7													
8	TOTAL ISSUES:		0	gallons							DEFUEL:	0	

Augmentation Row

Sheet tabs: CHART / DAILY \ ISSUES / JPSCLOSE / JPSWORKS / DEMAND
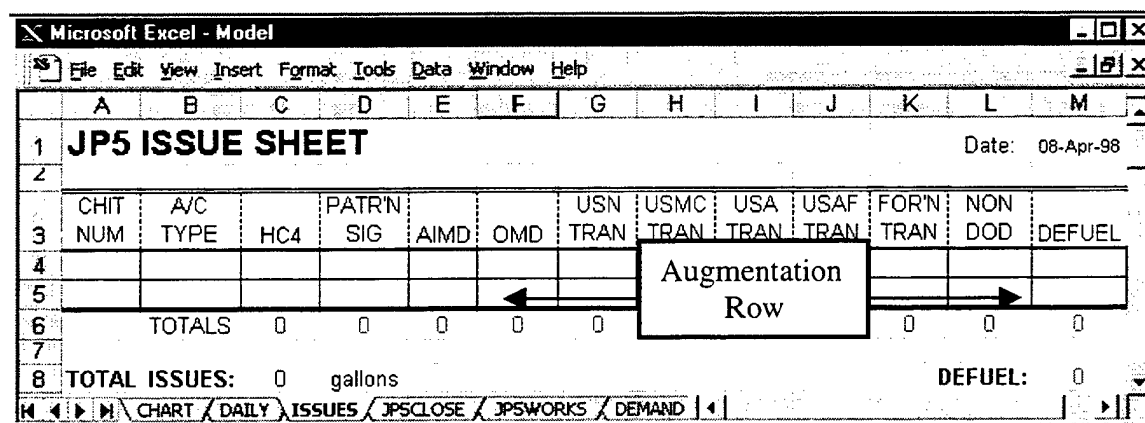
29. Select cell B6.

30. Type in the word "TOTALS". ↵

31. Select cell C6.

32. On the formula bar, below the toolbars, click the " = " sign. This tells Excel™ that the user is inserting a formula in cell C6.

33. Type " SUM(C4:C5) ". ↵

34. Select cell D6.

35. On the formula bar, below the toolbars, click the " = " sign. This tells Excel™ that the user is inserting a formula in cell D6.

36. Type " SUM(D4:D5) ". ↵

37. Select cell C6.

38. Highlight cells C6 and D6.

39. Drag the Auto Fill handle to the right on row 6. Release when the last category column has been reached.

40. Select cell A8.

41. Type the words "TOTAL ISSUES:". ↵

42. Select cell D8.

43. Type the word "gallons". ↵

44. Select cell C8.

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45. On the formula bar, below the toolbars, click the " = " sign. This tells Excel™ that the user is inserting a formula in cell C8.
46. Type " SUM(C6:M6) ".   ↵

Note: M6 represents the final issue category column on row 6. The letter "M" will be replaced by the column letter the user's final issue category is in. The last active column will be saved for the Defueled Category (e.g., column "N").

47. Select cell L8.
48. Type the word "DEFUEL".   ↵
49. Select cell M8.
50. On the formula bar, below the toolbars, click the " = " sign. This tells Excel™ that the user is inserting a formula in cell M8.
51. Select cell M6. This cell is under the DEFUEL Category column, in row 6. ↵

Note: Since there is only one defuel column, the same total under the DEFUEL Category column will appear in cell M8. Defueled is a category by itself, as mentioned in Chapter Three of the thesis.

52. Save ✗ ■.

Note: The user will start entering issues in row 4. After the first issue is recorded, the user should add rows as needed to the augmentation row (i.e., the last row before the totals). This is accomplished by highlighting the entire augmentation row, then choosing: Insert >> Row. Excel™ automatically changes the ranges on all of the SUM functions for the user.

c)   Sorting the Data

Excel™ allows the user to sort the data in different orders. This function eases the billing process by rearranging the rows by chit number, squadron or patron. To sort the issues by CHIT Number:

1.   Select cell A4.
2.   Click the Sort Ascending button on the Standard Toolbar.
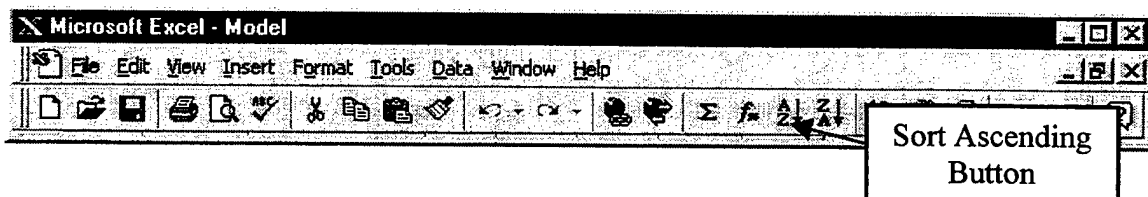
Note: Excel™ arranged the rows of information according to the data in column A, as shown below.

JP5 ISSUE SHEET — Date: 08-Apr-98

CHIT NUM	A/C TYPE	HC4	PATR'N SIG	AIMD	OMD	USN TRAN	USMC TRAN	USA TRAN	USAF TRAN	FOR'N TRAN	NON DOD	DEFUEL
11	VR-55					1738						
12	P-3			2976								
14	P-3			672								
17	VR-61											100
19	C-141								2600			
20	C-141								1349			
23	C-141								2704			
26	P-3											
27	C-130								2207			
41	H-53	1233										
42	P-3		3007									
46	ATA										1865	
48	NETH									2931		
49	H-53	819										
50	H-53	485										
51	VR-61					3728						
116	H-53	253										
118	C-17								4648			
184	P-3		1467									
185	C-9								2185			
TOTALS		2790	4474	3648	0	5466	0	0	15693	2931	1865	100

TOTAL ISSUES: 36867 gallons   **DEFUEL:** 100

CHART / DAILY \ ISSUES / JP5CLOSE / JP5WORKS / DEMAND

Note: The following will sort the rows by A/C Type, as shown below:

1. Select cell B4.
2. Click the Sort Ascending button on the Standard Toolbar.

```
X Microsoft Excel - Model                                    _ □ ×
 File  Edit  View  Insert  Format  Tools  Data  Window  Help        _ 8 ×
```

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	JP5 ISSUE SHEET											Date:	08-Apr-98
2													
3	CHIT NUM	A/C TYPE	HC4	PATR'N SIG	AIMD	OMD	USN TRAN	USMC TRAN	USA TRAN	USAF TRAN	FOR'N TRAN	NON DOD	DEFUEL
4	46	ATA										1865	
5	27	C-130								2207			
6	23	C-141								2704			
7	20	C-141								1349			
8	19	C-141								2600			
9	118	C-17								4648			
10	185	C-9								2185			
11	116	H-53	253										
12	50	H-53	485										
13	49	H-53	819										
14	41	H-53	1233										
15	48	NETH									2931		
16	184	P-3		1467									
17	42	P-3		3007									
18	26	P-3											
19	14	P-3			672								
20	12	P-3			2976								
21	11	VR-55					1738						
22	51	VR-61					3728						
23	17	VR-61											100
24													
25		TOTALS	2790	4474	3648	0	5466	0	0	15693	2931	1865	100
26													
27	TOTAL ISSUES: 36867	gallons									DEFUEL:	100	

```
H ◄ ► H \ CHART / DAILY \ ISSUES / JP5CLOSE / JP5WORKS / DEMAND | ◄ |                  ► |
```

3. Receipt Model

The user must construct a separate Receipt Model for each storage tank that can receive product from an outside source. The user must first build one complete Receipt Model that has links to the other models and databases, then make a copy. On the copy, the formulas must be deleted. Each Receipt Model is unique to a certain storage tank. Therefore, the formulas and links will change with the individual Receipt Model. As needed, the user should continue to make as many copies of the model without links. This process will save time and effort (i.e., typing, cell shading, formatting number of decimal places). Once the optimum number of models is reached, fill in the links to the other models and databases.

	A	B	C	D	E	F	G	H	I
1	RECEIVING REPORT					TANK: A		DATE:	1-Oct-98
2									
3	JP5								
5	OPENING INVENTORY								
6	1. GAUGE READING					235.3			
7	2. GROSS VOLUME OF FLUIDS IN TANK					435,997			
8	3. WATER CUT READING					0.0			
9	4. GROSS WATER VOLUME					0			
10	5. GROSS VOLUME OF FUEL (#2 - #4)					435,997			
11	6. MEASURED API OF SAMPLE					46.4			
12	7. MEASURED TEMPERATURE OF API SAMPLE					67.0			
13	8. API AT 60 F FROM TABLE 5B					45.8			
14	9. TEMPERATURE OF FUEL IN TANK					65.0			
15	10. CORRECTION FACTOR USING TABLE 6B					0.9974			
16	11. NET QUANTITY IN LITERS					434,863			
17	12. NET QUANTITY IN GALLONS					114,879			
18									
19	CLOSING INVENTORY (After receipt of product)								
20	13. GAUGE READING					354.0			
21	14. GROSS VOLUME OF FLUIDS IN TANK					652,745			
22	15. WATER CUT READING					0.0			
23	16. GROSS WATER VOLUME					0			
24	17. GROSS VOLUME OF FUEL (#14 - #16)					652,745			
25	18. MEASURED API OF SAMPLE					46.5			
26	19. MEASURED TEMPERATURE OF API SAMPLE					68.0			
27	20. API AT 60 F FROM TABLE 5B					45.8			
28	21. TEMPERATURE OF FUEL IN TANK					67.0			
29	22. CORRECTION FACTOR USING TABLE 6B					0.9964			
30	23. NET QUANTITY IN LITERS					650,395	liters		
31	24. NET QUANTITY IN GALLONS					171,816	gallons		
32									
33	25. NET QUANTITY RECEIVED (JP5)					56,937	gallons		
34									
35	METER CHECK								
36	26. BEGINNING METER READING					1,000,000			
37	27. ENDING METER READING					1,215,530			
38	28. METER READING DIFFERENCE (liters)					215,530			
39	29. METERED QUANTITY RECEIVED (gallons)					56,937			

RECEIPT / ReceiptB / ReceiptC / MG1 /

a)   Name the Third Worksheet

1. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 3". The white cross will turn into a pointer.
2. Double-click. The text portion will darken.
3. Type in the word "RECEIPT". ↵

b)   Entering the Receipt Layout

The Receipts Model has three parts: Opening Inventory, Closing Inventory, and Meter Check. The first tank in the Tanks Database (i.e., Tank A) will be used as the example.

(1)   Opening Inventory

1. Select cell A1.
2. Type in the words "RECEIVING REPORT". ↵
3. Select cell A1.
4. Choose   Font Size Selection >> 16 ↵
5. Select cell F1.
6. Type in the word "TANK:". ↵
7. Choose   Font Size Selection >> 16 ↵
8. Select cell H1.
9. Type in the word "Date:". ↵
10. Select cell I1.
11. Choose
    Format >> Cells >> Number (tab) >> Category: Date >> Type: 4-Mar-97 >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.

Note: The date that product is received will be a manual entry in cell I1.

12. Select cell A3.
13. Type in the name of the fuel (i.e., JP5, gasoline, diesel). ↵
14. Select cell A3.
15. Choose   Font Size Selection >> 16 ↵
16. Select cell A5.
17. Type in the words "OPENING INVENTORY". ↵
18. Select cell A6.
19. Type in the sentence " 1. GAUGE READING ". ↵
20. Select cell F6.

21. Choose
> Format >> Cells >> Patterns (tab) >> Cell Shading Color: select a light color. >> Pattern: select the color white. >> OK.
22. Continue to type in and shade the Opening Inventory Layout as shown below:

	A	B	C	D	E	F	G	H	I
1	RECEIVING REPORT					TANK: A		DATE:	
2									
3	JP5								
4									
5	OPENING INVENTORY								
6	1. GAUGE READING								
7	2. GROSS VOLUME OF FLUIDS IN TANK								
8	3. WATER CUT READING								
9	4. GROSS WATER VOLUME								
10	5. GROSS VOLUME OF FUEL (#2 - #4)								
11	6. MEASURED API OF SAMPLE								
12	7. MEASURED TEMPERATURE OF API SAMPLE								
13	8. API AT 60 F FROM TABLE 5B								
14	9. TEMPERATURE OF FUEL IN TANK								
15	10. CORRECTION FACTOR USING TABLE 6B								
16	11. NET QUANTITY IN LITERS								
17	12. NET QUANTITY IN GALLONS								
18									

DAILY / ISSUES / JP5CLOSE / JP5WORKS / DEMAND / GAS

23. Select cell F6.
24. Highlight down the column from F6 though F14.
25. Choose
> Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> OK.

Note: The uncorrected fuel height measurement will be a manual entry in cell F6.

26. Select cell F7.
27. Type in the following formula:

```
=VLOOKUP(F6,'C:\AThesis\[TANKS.xls]TANKS'!A3:B356,2)
+IF(F6<200,
VLOOKUP((F6*10)-INT(F6)*10,'C:\AThesis\[TANKS.xls]TANKS'!D4:E13,2),
VLOOKUP((F6*10)-INT(F6)*10,'C:\AThesis\[TANKS.xls]TANKS'!D18:E27,2)) ↵
```

Note: Refer to Chapter Three, Section D for explanation of the formula's functions and its link to the Tanks Database. The range A3:B356 will vary with the number of strapping chart entries for the user's first tank in the Tanks Database. The range D4:E13 is for the "less than 200 cm" (< 200 cm) interpolation table. The range D18:E27 is for the "greater than 200 cm" (> 200 cm) interpolation table.

Note: The height of the water will be a manual entry in cell F8.

28. Select cell F9.
29. Type in the following formula:

```
=IF(F8>0,VLOOKUP(F8,'C:\AThesis\[TANKS.xls]TANKS'!A3:B356,2)
+IF(F8<200,
VLOOKUP((F8*10)-INT(F8)*10,'C:\AThesis\[TANKS.xls]TANKS'!D4:E13,2),
VLOOKUP((F8*10)-INT(F8)*10,'C:\AThesis\[TANKS.xls]TANKS'!D18:E27,2)),0)
```
↵

Note: The ranges (A3:B356), (D4:E13), and (D18:E27) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

30. Select cell F10.
31. Type in the formula " =F7-F9 ". ↵

Note: The observed API will be a manual entry in cell F11. The sample temperature will be a manual entry in cell F12.

32. Select cell F13.
33. Type in the following formula:

```
=ROUND
(IF(F11>0,
(VLOOKUP(F12,'C:\Athesis\[TANKS.xls]API'!A3:AZ43,
MATCH(F11,'C:\Athesis\[TANKS.xls]API'!B2:AZ2,0)+1,FALSE)),0),1)
```
↵

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

Note: The tank temperature will be a manual entry in cell F14.

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34. Select cell F15.
35. Choose
    Format >> Cells >> Number (tab) >> Category: Number >> Decimal
    places: 4 >> OK.
36. Type in the following formula:

```
=IF(F13>0,
(VLOOKUP(F14,'C:\Athesis\[TANKS.xls]SIXB'!A3:AZ43,
MATCH(F13,'C:\Athesis\[TANKS.xls]SIXB'!B2:AZ2,0)+1,FALSE)),0)  ↵
```

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only.
The user must locate and utilize the database and range associated with the
particular tank. See Chapter Three of the thesis for details.

37. Select cell F16.
38. Highlight down the column from F16 though F17.
39. Choose
    Format >> Cells >> Number (tab) >> Category: Number >> Decimal
    places: 0 >> OK.
40. Select cell F16.
41. Type in the formula " =F10*F15 ". ↵
42. Select cell F17.
43. Type in the formula " =F16*0.264172 ". ↵

Note: The Opening Inventory section of the Receipts Model is complete.

(2)   Closing Inventory

1. Select cell A19.
2. Type in the words "CLOSING INVENTORY". ↵
3. Select cell A20.
4. Type in the sentence " 13. GAUGE READING ". ↵
5. Select cell F20.
6. Choose
    Format >> Cells >> Patterns (tab) >> Cell Shading Color: select a light
    color. >> Pattern: select the color white. >> OK.
7. Continue to type in and shade the Closing Inventory Layout as shown below:

```
X Microsoft Excel - Model                                    _ □ ×
 S]  File  Edit  View  Insert  Format  Tools  Data  Window  Help        _ 8 ×
         A  |    B    |   C   |   D   |    E   |   F   |    G      ▲
 18
 19  CLOSING INVENTORY (After receipt of product)
 20  13. GAUGE READING
 21  14. GROSS VOLUME OF FLUIDS IN TANK
 22  15. WATER CUT READING
 23  16. GROSS WATER VOLUME
 24  17. GROSS VOLUME OF FUEL (#14 - #16)
 25  18. MEASURED API OF SAMPLE
 26  19. MEASURED TEMPERATURE OF API SAMPLE
 27  20. API AT 60 F FROM TABLE 5B
 28  21. TEMPERATURE OF FUEL IN TANK
 29  22. CORRECTION FACTOR USING TABLE 6B
 30  23. NET QUANTITY IN LITERS                          liters
 31  24. NET QUANTITY IN GALLONS                         gallons
 32
 33  25. NET QUANTITY RECEIVED (JP5)              gallons
 34
 |◄ ◄ ► ►|\ DAILY / ISSUES / JP5CLOSE / JP5WORKS /| ◄ |        ►|
```

8. Select cell F20.
9. Highlight down the column from F20 though F28.
10. Choose

> Format >> Cells >> Number (tab) >> Category: Number >> Decimal places: 1 >> OK.

Note: The raw fuel height measurement will be a manual entry in cell F20.

11. Select cell F21.
12. Type in the following formula:

=VLOOKUP(F20,'C:\AThesis\[TANKS.xls]TANKS'!A3:B356,2)+IF(F20<200,
VLOOKUP((F20*10)-INT(F20)*10,'C:\AThesis\[TANKS.xls]TANKS'!D4:E13,2),
VLOOKUP((F20*10)-INT(F20)*10,'C:\AThesis\[TANKS.xls]TANKS'!D18:E27,2))
↵

Note: Refer to Chapter Three, Section D for explanation of the formula's functions and its link to the Tanks Database. The range A3:B356 will vary with the number of strapping chart entries for the user's first tank in the Tanks Database. The range D4:E13 is for the "less than 200 cm" interpolation table. The range D18:E27 is for the "greater than 200 cm" interpolation table.

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Note: The height of the water will be a manual entry in cell F22.

13. Select cell F23.
14. Type in the following formula:

=IF(F22>0,VLOOKUP(F22,'C:\AThesis\[TANKS.xls]TANKS'!A3:B356,2)
+IF(F22<200,
VLOOKUP((F22*10)-INT(F22)*10,'C:\AThesis\[TANKS.xls]TANKS'!D4:E13,2),
VLOOKUP((F22*10)-
INT(F22)*10,'C:\AThesis\[TANKS.xls]TANKS'!D18:E27,2)),0) ↵

Note: The ranges (A3:B356), (D4:E13), and (D18:E27) are for demonstration
purposes only. The user must locate and utilize the database and range
associated with the particular tank. See Chapter Three of the thesis for
details.

15. Select cell F24.
16. Type in the formula " =F21-F23 ". ↵

Note: The observed API will be a manual entry in cell F25.
The sample temperature will be a manual entry in cell F26.

17. Select cell F27.
18. Type in the following formula:

=ROUND
(IF(F25>0,
(VLOOKUP(F26,'C:\Athesis\[TANKS.xls]API'!A3:AZ43,
MATCH(F25,'C:\Athesis\[TANKS.xls]API'!B2:AZ2,0)+1,FALSE)),0),1) ↵

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only.
The user must locate and utilize the database and range associated with the
particular tank. See Chapter Three of the thesis for details.

Note: The tank temperature will be a manual entry in cell F28.

19. Select cell F29.
20. Choose
Format >> Cells >> Number (tab) >> Category: Number >> Decimal
places: 4 >> OK.

21. Type in the following formula:

```
=IF(F27>0,
(VLOOKUP(F28,'C:\Athesis\[TANKS.xls]SIXB'!A3:AZ43,
MATCH(F27,'C:\Athesis\[TANKS.xls]SIXB'!B2:AZ2,0)+1,FALSE)),0)  ↵
```

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only.
The user must locate and utilize the database and range associated with the
particular tank. See Chapter Three of the thesis for details.

22. Select cell F30.
23. Highlight down the column from F30 though F31.
24. Choose
Format >> Cells >> Number (tab) >> Category: Number >> Decimal
places: 0 >> OK.
25. Select cell F30.
26. Type in the formula " =F24*F29 ". ↵
27. Select cell F31.
28. Type in the formula " =F30*0.264172 ". ↵
29. Select cell F33.
30. Type in the formula " =F31-F17 ". ↵

Note: The Closing Inventory section of the Receipts Model is complete.

(3)   Meter Check

1. Select cell A35.
2. Type in the words "METER CHECK". ↵
3. Select cell A36.
4. Type in the sentence " 26. BEGINNING METER READING ". ↵
5. Select cell F36.
6. Choose
Format >> Cells >> Patterns (tab) >> Cell Shading Color: select a light
color. >> Pattern: select the color white. >> OK.
7. Continue to type in and shade the Closing Inventory Layout as shown below:

```
 X Microsoft Excel - Model                                    [_][□][X]
[N] File  Edit  View  Insert  Format  Tools  Data  Window  Help    [_][₫][X]
         A          B          C          D          E          F          G
 34
 35  METER CHECK
 36  26. BEGINNING METER READING
 37  27. ENDING METER READING
 38  28. METER READING DIFFERENCE (liters)
 39  29. METERED QUANTITY RECEIVED (gallons)
 40
 41  30. DIFFERENCE (gauge/meter)                                gallon(s)
[K][◄][►][►]\ DAILY \ ISSUES \ JP5CLOSE \ JP5WORKS [◄]
```

Note: The Beginning Meter Reading will be a manual entry in cell F36. The Ending Meter Reading will be a manual entry in cell F37.

8. Select cell A38.
9. Type in the formula " =F37-F36 ". ↵
10. Select cell F39.
11. Type in the formula " =F38*0.264172 ". ↵
12. Save ✄ ◘.

Note: The Meter Check section of the Receipts Model is complete.

4. JP5 Works Model

The JP5 Works Model is divided into three areas: Fuel Storage Tank Inventory, Fuel Truck Inventory, and Book Inventory.

TANK	GAUGE	WATER CUT	GAUGE TRUE	GROSS VOLUME	OBS API	SAMP TEMP	CORR API	TANK TEMP	CORR FACTOR	TOTAL liters	TRUCKS #	Gallons
A	85	0	85	161478	45.3	61.0	44.8	68.0	0.9959	160,815.9	934	4,416.0
B	84.6	0	84.6	167365	45.2	62.0	45.0	68.0	0.9959	166,678.8	125	1,994.2
C	198	0	198	382098	46.0	60.0	46.0	68.0	0.9958	380,493.2	318	0.0
3	70.3	3	67.3	13057	45.4	62.0	45.2	68.0	0.9959	13,003.8	319	4,827.8
4	100	0	100	25472	45.0	62.0	44.8	70.0	0.9948	25,339.5	320	4,827.8
D1	319	0	319	192983	47.0	70.0	46.1	75.0	0.9922	191,477.2	258	4,988.0
D2	232	0	232	140436	47.5	70.0	46.6	75.0	0.9921	139,326.7	115	4,642.0
D3	300.1	0	300.1	183563	44.9	69.0	44.1	72.0	0.9939	182,442.8	365	4,826.0
D4	222.6	0	222.6	133788	46.5	68.0	45.8	73.0	0.9932	132,878.4	661	4,737.0
										1,392,456.3	841	4,737.0
												39,995.8

JP5 DAILY CLOSE-OUT

DATE: 08-Apr-98

TOTAL TANK LITERS 1,392,456

CONVERT TO GALLONS	367,848
TOTAL PIPELINE GALLONS	39,182
TRUCKS	39,996
TOTAL PHYSICAL INVENTORY	447,026

JP-5 BOOK (yesterdays close)	450,000
RECEIVED (+)	57,058
ISSUES (-)	62,377
DEFUELED (+)	100
	444,781

DAILY DIFFERENCE 2,244 Gallons

REMARKS:

REVIEWED BY:

a) Create and Name the Fourth Worksheet

1. Choose Insert >> Worksheet.
   A new tab called "Sheet 4" will appear at the bottom of the viewing area.
2. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 4". The white cross will turn into a pointer.
3. Double-click. The text portion will darken.
4. Type in the word "JP5Works". ↵
5. Choose Edit >> Move or Copy Sheet >> Move to end >> OK.

b) Entering the Storage Tank Layout

1. Select cell A1.
2. Type in the name of the report (i.e., JP5 DAILY CLOSE-OUT). ↵
3. Select cell A1.
4. Choose Font Size Selection >> 14 ↵
5. Select cell A3.
6. Type in the word "DATE". ↵
7. Select cell B3.
8. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula, or linking data from another model to cell B3.
9. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

10. Select cell I1 (i.e., the shaded manual entry date cell).

Note: "=DAILY!I1" will be displayed in the formula bar.

11. Click on OK.
12. Select cell A5.
13. Type the word "TANK". ↵
14. Continue to type in the Storage Tank Inventory Layout as shown below:

	A	B	C	D	E	F	G	H	I	J	K
1	**JP5 DAILY CLOSE-OUT**										
2											
3	DATE:	08-Apr-98									
4											
5	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL
6			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters

B3 = =DAILY!I1

\\ DAILY / ISSUES / RECEIPT \ JP5WORKS /

15. Select cell A7.
16. Type the name of the first storage tank (i.e., A). ↵
17. Select cell B7.
18. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B7.
19. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

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20. Select cell B9 (i.e., the shaded manual entry cell for the gauge reading on tank A).

Note: "=DAILY!B9" will be displayed in the formula bar.

21. Click on OK.
22. Select cell C7.
23. On the formula bar, below the toolbars, click the " = " sign.
24. Click on the Daily Model tab.
25. Select cell D9 (i.e., the shaded manual entry cell for the water reading on tank A).

Note: "=DAILY!D9" will be displayed in the formula bar.

26. Click on OK.
27. Select cell D7.
28. Type in the formula " =B7-C7 ". ↵
29. Select cell E7.
30. Type in the formula:

=VLOOKUP(D7,'C:\AThesis\[TANKS.xls]TANKS'!A3:B356,2)
+IF(D7<200,
VLOOKUP((D7*10)-INT(D7)*10,'C:\AThesis\[TANKS.xls]TANKS'!D4:E13,2),
VLOOKUP((D7*10)-INT(D7)*10,'C:\AThesis\[TANKS.xls]TANKS'!D18:E27,2)) ↵

Note: The ranges (A3:B356), (D4:E13), and (D18:E27) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

31. Select cell F7.
32. On the formula bar, below the toolbars, click the " = " sign.
33. Click on the Daily Model tab.
34. Select cell E9 (i.e., the shaded manual entry cell for the observed API).

Note: "=DAILY!E9" will be displayed in the formula bar.

35. Click on OK.
36. Select cell G7.
37. On the formula bar, below the toolbars, click the " = " sign.
38. Click on the Daily Model tab.
39. Select cell C9 (i.e., the shaded manual entry cell for the sample temperature).

Note: "=DAILY!C9" will be displayed in the formula bar.

40. Click on OK.
41. Select cell H7.
42. Type in the formula:

```
=ROUND(IF(F7>0,(VLOOKUP(G7,'C:\AThesis\[TANKS.xls]API'!A3:AZ43,
MATCH(F7,'C:\AThesis\[TANKS.xls]API'!B2:AZ2,0)+1,FALSE)),0),1)   ↵
```

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only.
The user must locate and utilize the database and range associated with the
particular tank. See Chapter Three of the thesis for details.

43. Select cell I7.
44. On the formula bar, below the toolbars, click the " = " sign.
45. Click on the Daily Model tab.
46. Select cell F9 (i.e., the shaded manual entry cell for the fuel in the storage tank
temperature).

Note: "=DAILY!F9" will be displayed in the formula bar.

47. Click on OK.
48. Select cell J7.
49. Type in the formula:

```
=IF(H7>0,(VLOOKUP(I7,'C:\AThesis\[TANKS.xls]SIXB'!A3:AZ43,
MATCH(H7,'C:\AThesis\[TANKS.xls]SIXB'!B2:AZ2,0)+1,FALSE)),0)   ↵
```

Note: The ranges (A3:AZ43) and (B2:AZ2) are for demonstration purposes only.
The user must locate and utilize the database and range associated with the
particular tank. See Chapter Three of the thesis for details.

50. Select cell K7.
51. Type in the formula " =E7*J7 ".   ↵
52. Save work periodically and upon completion, ✂ ▣.

Note: The Storage Tank Inventory for Tank A is complete.

Note: Continue the procedure for steps 15 through 51 for the remaining tanks.

53. After all of the tanks have been entered, add a SUM function below the last
tank entry in column K. Example: if there were nine tanks, the formula would
look like " =SUM(K7:K15) ".

Note: This is the total volume of fuel in all of the storage tanks combined.

c)   Entering the Fuel Truck Inventory

1. Select cell M5.
2. Type the word "TRUCK". ⏎
3. Select cell N5.
4. Type the word "Gallons". ⏎
5. Select cell M6.
6. Type the letter " # ". ⏎
7. Select cell M7.
8. Type the number of the first truck (i.e., 934). ⏎
9. Select cell N7.
10. On the formula bar, below the toolbars, click the " = " sign.
11. Click on the Daily Model tab.
12. Select cell J9 (i.e., the shaded manual entry cell for the gauge measurement).

Note: "=DAILY!F9" will be displayed in the formula bar.

13. Select cell F9 (i.e., the shaded manual entry cell for the fuel in the storage tank temperature).
14. Click on OK.
15. Save work periodically and upon completion, � ▣.

Note: Continue the procedure for steps 7 through 15 for the remaining trucks.

16. After all of the trucks have been entered, add a SUM function below the last truck entry in column N. Example: If there were ten trucks, the formula would look like " =SUM(N7:N16) ".

Note: This is the total volume of fuel in all of the fuel trucks combined.

d)   Entering the Book Inventory

1. Select cell A19.
2. Type the words "TOTAL TANK LITERS". ⏎
3. Select cell C19.
4. On the formula bar, below the toolbars, click the " = " sign.
5. Click on the cell where the SUM function for the storage tanks was entered (i.e., step 52 in the Entering the Storage Tank Inventory section). ⏎
6. Select cell A21.

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7. Type the words "CONVERT TO GALLONS". ↵
8. Select cell D21.
9. Type in the formula " C19*0.264172 ". ↵
10. Select cell A22.
11. Type in the words "TOTAL PIPELINE GALLONS". ↵
12. Select cell D22.
13. Type in the constant number of gallons that remains in the pipeline at the fuel farm (e.g., 39,182 gallons at Sigonella). ↵
14. Select cell A23.
15. Type in the word "TRUCK". ↵
16. Select cell D23.
17. On the formula bar, below the toolbars, click the " = " sign.
18. Click on the cell where the SUM function for the fuel trucks was entered (i.e., step 16 in the Entering the Fuel Truck Inventory section). ↵
19. Select cell A24.
20. Type the words "TOTAL PHYSICAL INVENTORY". ↵
21. Select cell E24.
22. On the formula bar, below the toolbars, click the " = " sign.
23. Type in the formula " SUM(D21:D23) ". ↵
24. Select cell A27.
25. Type the words "JP5 BOOK (Yesterday's close)". ↵
26. Select cell D27.
27. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B3.
28. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

29. Select cell C5 (i.e., the shaded manual entry cell for yesterday's close).

Note: "=DAILY!C5" will be displayed in the formula bar.

30. Click on OK.
31. Select cell A28.
32. Type the word "RECEIVED(+)". ↵
33. Select cell D28.
34. Focus is on the total amount of JP5 gallons received for the day. Each of the JP5 Receipt Models must be linked together to arrive at this total. In each Receipt Model, the totals are located in cell F33. Example: if there were two JP5 Receipt Models, ReceiptA and ReceiptB, the formula would look like " =ReceiptA!F33+ ReceiptB!F33 ". ↵
35. Select cell A29.

36. Type the word "ISSUES(-)". ↵
37. Select cell D29.
38. On the formula bar, below the toolbars, click the " = " sign.
39. Click on the Issues Model tab.
40. Select cell C8 (i.e., the sum of the totals located at the bottom of the Issues Model).

Note: As rows are added to the augmentation row in the Issues Model, Excel™ automatically updates the link in the JP5 Works Model.

41. Click on OK.
42. Select cell A30.
43. Type the word "DEFUELED(+)". ↵
44. Select cell D30.
45. On the formula bar, below the toolbars, click the " = " sign.
46. Click on the Issues Model tab.
47. Select cell M8.
48. Click on OK.
49. Select cell E31.
50. On the formula bar, below the toolbars, click the " = " sign.
51. Type in the formula " D27+D28-D29+D30 ". ↵
52. Select cell A32.
53. Type the words "DAILY DIFFERENCE". ↵
54. Select cell F32.
55. Type in the formula " =E24-E31 ". ↵
56. Select cell G32.
57. Type the word "gallons". ↵
58. Save work upon completion, �.

Note: The JP5 Works Model is complete.

e)   Using the JP5 Works Model

This model is completely automatic (i.e., no manual entry required). It is recommended that the Fuel Officer review this model on a daily basis. JP5 Works compares the physical and book fuel inventory totals to determine if there are any discrepancies (i.e., cell F32).

5. JP5 Close Model

```
X Microsoft Excel - ModelCHARTS2                                    _ □ X
File  Edit  View  Insert  Format  Tools  Data  Window  Help           _ 8 X
```

Arial ▾ 10 ▾ **B** *I* <u>U</u> ≡ ≡ ≡ 🗒 $ % , ⁺⁰ ⁺⁰ ≡ ▾ ▾ **A** ▾

C8 ▾ = =JP5WORKS!K8

	A	B	C	D	E	F	G	H
1	**JP5 DAILY CLOSE-OUT SUMMARY**							
2								
3	DATE:	08-Apr-98						
4								
5								
6	**TANK**	**GAUGE cm**	**TOTAL in liters**		**TRUCK**	**GAUGE inch**	**TOTAL in gallons**	
7	A	85.0	160,816		934	46	4,416	
8	B	84.6	166,679		125	21	1,994	
9	C	198.0	380,493		318	0	0	
10	3	67.3	13,004		319	47	4,828	
11	4	100.0	25,340		320	47	4,828	
12	D1	319.0	191,477		258	48	4,988	
13	D2	232.0	139,327		115	43	4,642	
14	D3	300.1	182,443		365	45	4,826	
15	D4	222.6	132,878		661	44	4,737	
16	TOTAL LITERS		1,392,456		841	44	4,737	
17	CONVERSION INTO GALLONS		367,848				39,996	
18								
19								
20	TANK GALLONS		367,848					
21	TRUCK GALLONS		39,996					
22	PIPELINE GALLONS		39,182					
23								
24	**TOTAL INVENTORY**		**447,026** gallons					

`|◄ ◄ ► ►|\ CHART / DAILY / ISSUES \ JP5CLOSE / JP5WORKS / DE| ◄|`

a) Create and Name the Fifth Worksheet

1. Choose Insert >> Worksheet.
   A new tab called "Sheet 5" will appear at the bottom of the viewing area.
2. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 5". The white cross will turn into a pointer.
3. Double-click. The text portion will darken.
4. Type in the word "JP5Close". ⏎
5. Choose Edit >> Move or Copy Sheet >> Move to end >> OK.

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b)   Entering the Storage Tank Layout

1. Select cell A1.
2. Type in the name of the report (i.e., JP5 DAILY CLOSE-OUT SUMMARY). ↵
3. Select cell A1.
4. Choose   Font Size Selection >> 14   ↵
5. Select cell A3.
6. Type in the word "DATE".   ↵
7. Select cell B3.
8. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B3.
9. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

10. Select cell I1 (i.e., the shaded manual entry date cell).

Note: "=DAILY!I1" will be displayed in the formula bar.

11. Click on OK.
12. Select cell A6.
13. Type the word "TANK".   ↵
14. Select cell B6.
15. Type the word "GAUGE cm".   ↵
16. Select cell C6.
17. Type the word "TOTAL in liters".   ↵
18. Select cell A7.
19. Type in the name of the first tank (i.e., A).   ↵
20. Select cell B7.
21. On the formula bar, below the toolbars, click the " = " sign.
22. Click on the JP5 Works Model tab.
23. Select cell D7 (i.e., the gauge true cell).
24. Click on OK.
25. Select cell C7.
26. On the formula bar, below the toolbars, click the " = " sign.
27. Click on the JP5 Works Model tab.
28. Select cell K7 (i.e., the total liters for tank A cell).
29. Click on OK.
30. Highlight cells B7 and C7.
31. Drag the Auto Fill handle down the same number of rows, as there are tanks.
32. Click anywhere in column D to remove the highlighting of the area.

33. Select cell B16.
34. Type in the words "TOTAL LITERS". ↵
35. Select cell C16.
36. Type in the formula " =SUM(C7:C15) ". ↵
37. Select cell A17.
38. Type in the words "CONVERSION INTO GALLONS". ↵
39. Select cell C17.
40. Type in the formula " =C16*0.264172 ". ↵
41. Save work periodically and upon completion, ✂ ▤.

Note: Cell borders are optional, but highly recommended.

c)   Entering the Fuel Truck Layout

1. Select cell E6.
2. Type the word "TRUCK". ↵
3. Select cell G6.
4. Type the word "GAUGE inch". ↵
5. Select cell H6.
6. Type the word "TOTAL in gallons". ↵
7. Select cell E7.
8. Type in the number of the first truck (i.e., 934). ↵
9. Select cell F7.
10. On the formula bar, below the toolbars, click the " = " sign.
11. Click on the Daily Model tab.
12. Select cell J9 (i.e., the gauge in inches cell).
13. Click on OK.
14. Select cell G7.
15. On the formula bar, below the toolbars, click the " = " sign.
16. Click on the JP5 Works Model tab.
17. Select cell N7 (i.e., the total gallons in truck 934 cell).
18. Click on OK.
19. Highlight cells F7 and G7.
20. Drag the Auto Fill handle down the same number of rows, as there are trucks.
21. Click anywhere in column D to remove the highlighting of the area.
22. Select cell G17.
23. Type in the formula " =SUM(G7:G16) ". ↵
24. Select cell B20.
25. Type the words "TANK GALLONS". ↵
26. Select cell C20.
27. Type in the formula " =C17 " ↵

28. Select cell B21.
29. Type the words "TRUCK GALLONS". ↵
30. Select cell C21.
31. Type in the formula " =G17 " ↵
32. Select cell B22.
33. Type the words "PIPELINE GALLONS". ↵
34. Select cell C22.
35. Type in the pipeline constant (e.g. 39,182 gallons for Sigonella). ↵
36. Select cell B24.
37. Type the words "TOTAL INVENTORY". ↵
38. Select cell C24.
39. Type in the formula " =SUM(C20:C22) ". ↵
40. Select cell D24.
41. Type the word "gallons". ↵
42. Save work periodically and upon completion, ✄ ◪.

Note: This model does not require any manual entries. Protecting the model is
    recommended.

43. Choose

    Tools >> Protection >> Protect sheet >> Contents, objects, scenarios
    (all ✓) >> OK.
44. Save ✄ ◪.

Note: The JP5 Close Model is complete.

d)   Using the JP5 Close Model

This model is completely automatic (i.e., no manual entry required). The
model provides a daily summary version of the JP5 Works Model for the Fuel
Officer.

6.   Gas Station Model

```
X Microsoft Excel - Model                                                    _ □ X
File  Edit  View  Insert  Format  Tools  Data  Window  Help                  _ ₴ X
```

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	GAS STATION CLOSE-OUT												
3	DATE:	08-Apr-98											
5	OPENING INVENTORY												
6	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
7			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		START
8	MG1	109	0	109	16965	63.3	68	62.2	64	0.9972	16917.5		1379203
9	MG2	58	4.5	53.5	6739	63.2	68	62.1	63	0.9979	6724.8		1932816
10								UNLEADED RECEIVED:			29,021.9		
11								TOTAL UNLEADED			52,664.3		
12													
13	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
14			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		START
15	DFM	225	8	217	39315	40.3	73	39.2	64	0.9981	39240.3		1739928
16	T-10	115.5	0	115.5	31874	40.5	68	39.8	63	0.9985	31825.7		2866607
17								DIESEL RECEIVED:			10,951.8		
18								TOTAL DIESEL			82,017.7		
20	CLOSING INVENTORY												
21	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
22			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		END
23	MG1	180	0	180	26796	62.5	76	60.4	76	0.9890	26501.2		1379203
24	MG2	145.7	3	142.7	22744	62.4	76	60.3	76	0.9890	22493.9		1936453
25								TOTAL UNLEADED			48,995.2		
28	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
29			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		END
30	DFM	219.8	3	216.8	39285	40	78	38.6	78	0.9914	38947.5		1751956
31	T-10	115.5	0	115.5	31874	40.4	78	38.9	78	0.9913	31596.2		2866607
32								TOTAL DIESEL			70,543.7		
34									UNLEADED		DIESEL		
35								PHYSICAL (CLOSE INV.)		48,995.2			70,543.7
37								BOOK (OPENING INV.)	23,642.3		71,066.0		
38								RECEIVED (+)	29,021.9		10,951.8		
39								ISSUED (-)	3,637.0		12,028.0		
40								BOOK TOTAL		49,027.3			69,989.7
41									gallons	liters	gallons	liters	
42								DAILY DIFFERENCE	-8.5	(32.1)	146.4	554.0	

```
|◄ ◄ ► ►|\ DAILY / ISSUES / ReceiptA / JPSWORKS / JPSCLOSE |◄|                    ►|
```

a)   Create and Name the Sixth Worksheet

1.   Choose   Insert >> Worksheet.
     A new tab called "Sheet 6" will appear at the bottom of the viewing area.
2.   Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 6". The white cross will turn into a pointer.
3.   Double-click. The text portion will darken.
4.   Type in the word "GAS". ↵
5.   Choose   Edit >> Move or Copy Sheet >> Move to end >> OK.

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b)   Entering the Opening Inventory

1. Select cell A1.
2. Type in the name of the report (i.e., GAS STATION CLOSE-OUT). ↵
3. Select cell A1.
4. Choose Font Size Selection >> 14   ↵
5. Select cell A3.
6. Type in the word "DATE:".   ↵
7. Select cell B3.
8. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B3.
9. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

10. Select cell I1 (i.e., the shaded manual entry date cell).

Note: "=DAILY!I1" will be displayed in the formula bar.

11. Click on OK.
12. Select cell A5.
13. Type the words "OPENING INVENTORY".   ↵
14. Select cell A6.
15. Type the word "TANK".   ↵
16. Select cell B6.
17. Continue to type in the Storage Tank Inventory Layout as shown below:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**GAS STATION CLOSE-OUT**												
2													
3	DATE:	08-Apr-98											
4													
5	OPENING INVENTORY												
6	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
7			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		START

CHART / DAILY / ISSUES / JPSCLOSE / JPSWORKS / DEMAND \ GAS / Req

18. Select cell A8.
19. Type the name of the first storage tank (i.e., MG1).   ↵
20. Select cell B8.
21. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B8.

22. Click on the Daily Model tab. This tab is located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

23. Select cell B27 (i.e., the shaded manual entry cell for the gauge reading on tank MG1).

Note: "=DAILY!B27" will be displayed in the formula bar.

24. Click on OK.
25. Select cell C8.
26. On the formula bar, below the toolbars, click the " = " sign.
27. Click on the Daily Model tab.
28. Select cell D27 (i.e., the shaded manual entry cell for the water reading on tank MG1).

Note: "=DAILY!D27" will be displayed in the formula bar.

29. Click on OK.
30. Select cell D8.
31. Type in the formula " =B8-C8 ". ↵
32. Select cell E8.
33. Type in the formula:

```
=VLOOKUP(D8,'C:\AThesis\[TANKS.xls]TANKS'!A3:B183,2)
+VLOOKUP(D8,'C:\AThesis\[TANKS.xls]TANKS'!A3:D183,4)
*((D8*10)-INT(D8)*10)     ↵
```

Note: The ranges (A3:B183) and (A3:D183) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

34. Select cell F8.
35. On the formula bar, below the toolbars, click the " = " sign.
36. Click on the Daily Model tab.
37. Select cell E27 (i.e., the shaded manual entry cell for the observed API).

Note: "=DAILY!E27" will be displayed in the formula bar.

38. Click on OK.
39. Select cell G8.
40. On the formula bar, below the toolbars, click the " = " sign.
41. Click on the Daily Model tab.

42. Select cell C27 (i.e., the shaded manual entry cell for the sample temperature).

Note: "=DAILY!C27" will be displayed in the formula bar.

43. Click on OK.
44. Select cell H8.
45. Type in the formula:

=ROUND(IF(F8>0,(VLOOKUP(G8,'C:\AThesis\[TANKS.xls]API'!A48:AZ86, MATCH(F8,'C:\AThesis\[TANKS.xls]API'!B47:AZ47,0)+1,FALSE)),0),1) ↵

Note: The ranges (A48:AZ86) and (B47:AZ47) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

46. Select cell I8.
47. On the formula bar, below the toolbars, click the " = " sign.
48. Click on the Daily Model tab.
49. Select cell F27 (i.e., the shaded manual entry cell for the fuel in the storage tank temperature).

Note: "=DAILY!F27" will be displayed in the formula bar.

50. Click on OK.
51. Select cell J8.
52. Type in the formula:

=IF(H8>0,(VLOOKUP(I8,'C:\AThesis\[TANKS.xls]SIXB'!A48:AZ86, MATCH(H8,'C:\AThesis\[TANKS.xls]SIXB'!A47:AZ47,0)+1,FALSE)),0) ↵

Note: The ranges (A48:AZ86) and (A47:AZ47) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

53. Select cell K8.
54. Type in the formula " =E8*J8 ". ↵
55. Select cell M8.
56. Type in the numbers from the meter at the time of the Opening Inventory. ↵
57. Save work periodically and upon completion, � ■.

Note: The Opening Inventory for Tank MG1 is complete.

Note: Continue the procedure for steps 18 through 57 for the remaining gasoline tanks.

58. Select cell I10.
59. Type the words "UNLEADED RECEIVED:". ↵
60. Select cell K10.
61. Focus is on the total amount of gasoline gallons received for the day. Each of the gasoline Receipt Models must be linked together to arrive at this total. In each Receipt Model, the totals are located in cell F33. Example: if there were two gasoline Receipt Models, ReceiptA and ReceiptB, the formula would look like " =ReceiptA!F33+ ReceiptB!F33 ". ↵
62. Select cell I11.
63. Type the words "TOTAL UNLEADED:". ↵
64. Select cell K11.
65. Type the formula " =SUM(K8:K10) ". ↵

Note: The databases for both diesel and gasoline are arranged in the same format. The procedures in the formulas and interpolations are the same throughout the model for both fuels, with the exception of the references to their respective databases. Therefore, only one set of procedures (i.e., gasoline) will be discussed for both fuels.

c)   Entering the Closing Inventory

1. Select cell A20.
2. Type the words "CLOSING INVENTORY". ↵
3. Select cell A21.
4. Type the word "TANK". ↵
5. Select cell B21.
6. Continue to type in the Storage Tank Inventory Layout as shown below:

	A	B	C	D	E	F	G	H	I	J	K	L	M
20	CLOSING INVENTORY			(									
21	TANK	GAUGE	WATER	GAUGE	GROSS	OBS	SAMP	CORR	TANK	CORR	TOTAL		METER
22			CUT	TRUE	VOLUME	API	TEMP	API	TEMP	FACTOR	liters		END

CHART / DAILY / ISSUES / JPSCLOSE / JPSWORKS / DEMAND \ GAS / Rec

7. Select cell A23.
8. Type the name of the first storage tank (i.e., MG1). ↵
9. Select cell B23.
10. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell B23.
11. Click the Daily Model tab located to the left of the Issue Model tab.

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Note: "=DAILY!" will be displayed in the formula bar.

12. Select cell H27 (i.e., the shaded manual entry cell for the gauge reading on tank MG1).

Note: "=DAILY!H27" will be displayed in the formula bar.

13. Click on OK.
14. Select cell C23.
15. On the formula bar, below the toolbars, click the " = " sign.
16. Click on the Daily Model tab.
17. Select cell J27 (i.e., the shaded manual entry cell for the water reading on tank MG1).

Note: "=DAILY!J27" will be displayed in the formula bar.

18. Click on OK.
19. Select cell D23.
20. Type in the formula " =B23-C23 ". ↵
21. Select cell E23.
22. Type in the formula:

=VLOOKUP(D23,'C:\AThesis\[TANKS.xls]TANKS'!A3:B183,2)
+VLOOKUP(D23,'C:\AThesis\[TANKS.xls]TANKS'!A3:D183,4)
*((D23*10)-INT(D23)*10)   ↵

Note: The ranges (A3:B183) and (A3:D183) are for demonstration purposes only. The user must locate and utilize the database and range associated with the particular tank. See Chapter Three of the thesis for details.

23. Select cell F23.
24. On the formula bar, below the toolbars, click the " = " sign.
25. Click on the Daily Model tab.
26. Select cell K27 (i.e., the shaded manual entry cell for the observed API).

Note: "=DAILY!K27" will be displayed in the formula bar.

27. Click on OK.
28. Select cell G23.
29. On the formula bar, below the toolbars, click the " = " sign.
30. Click on the Daily Model tab.
31. Select cell I27 (i.e., the shaded manual entry cell for the sample temperature).

Note: "=DAILY!I27" will be displayed in the formula bar.

32. Click on OK.
33. Select cell H23.
34. Type in the formula:

=ROUND(IF(F23>0,(VLOOKUP(G23,'C:\AThesis\[TANKS.xls]API'!A48:AZ86,
MATCH(F23,'C:\AThesis\[TANKS.xls]API'!B47:AZ47,0)+1,FALSE)),0),1) ↵

Note: The ranges (A48:AZ86) and (B47:AZ47) are for demonstration purposes
only. The user must locate and utilize the database and range associated
with the particular tank. See Chapter Three of the thesis for details.

35. Select cell I23.
36. On the formula bar, below the toolbars, click the " = " sign.
37. Click on the Daily Model tab.
38. Select cell L27 (i.e., the shaded manual entry cell for the fuel in the storage
tank temperature).

Note: "=DAILY!L27" will be displayed in the formula bar.

39. Click on OK.
40. Select cell J23.
41. Type in the formula:

=IF(H23>0,(VLOOKUP(I23,'C:\AThesis\[TANKS.xls]SIXB'!A48:AZ86,
MATCH(H23,'C:\AThesis\[TANKS.xls]SIXB'!A47:AZ47,0)+1,FALSE)),0) ↵

Note: The ranges (A48:AZ86) and (A47:AZ47) are for demonstration purposes
only. The user must locate and utilize the database and range associated
with the particular tank. See Chapter Three of the thesis for details.

42. Select cell K23.
43. Type in the formula " =E23*J23 ". ↵
44. Select cell M23.
45. Type in the numbers from the meter at the time of the Closing Inventory. ↵
46. Save work periodically and upon completion, �винного ■.

Note: The Closing Inventory for Tank MG1 is complete.

Note: Continue the procedure for steps 3 through 46 for the remaining gasoline
tanks.

47. Select cell I25.
48. Type the words "TOTAL UNLEADED:". ↵
49. Select cell K25.
50. Type the formula " =SUM(K23:K24) ". ↵

d)   Entering the Book Inventory

1. Select cell J34.
2. Type the word "UNLEADED". ↵
3. Select cell H35.
4. Type the word "PHYSICAL (CLOSE INV.)". ↵
5. Select cell H37.
6. Continue to type in the Book Inventory Layout as shown below:

```
X Microsoft Excel - Model                                    _ □ ×
File  Edit  View  Insert  Format  Tools  Data  Window  Help        _ 8 ×
       G        H          I          J          K          L         M
  33
  34                                        UNLEADED              DIESEL
  35          PHYSICAL (CLOSE INV.)                 48,995.2               70,543.7
  36
  37          BOOK (OPENING INV.)    23,642.3              71,066.0
  38          RECEIVED ( + )         29,021.9              10,951.8
  39          ISSUED ( - )            3,637.0              12,028.0
  40          BOOK TOTAL                    49,027.3               69,989.7
  41                                  gallons    liters    gallons    liters
  42          DAILY DIFFERENCE         -8.5      (32.1)     146.4     554.0
  43
 GAS
```

7. Select cell K35.
8. Type in the formula " =K25 ". ↵
9. Select cell J37.
10. Type in the formula " =K8 ". ↵
11. Select cell J38.
12. Type in the formula " =K10 ". ↵
13. Select cell J39.
14. Type in the formula " =M23-M8 ". ↵
15. Select cell K40.
16. Type in the formula " =J37+J38-J39 ". ↵
17. Select cell K42.
18. Type in the formula " =K35-K40 ". ↵
19. Select cell J42.

20. Type in the formula " =K42*0.264172 ".   ↵
21. Save work upon completion, �✗◨ .

Note: The Gas Station Model is complete.

e)   Using the Gas Station Model

This model is completely automatic (i.e., no manual entry required). It is recommended that the Fuel Officer review this model on a daily basis. The Book Inventory area compares the book inventory against the physical inventory. It is the responsibility of the Fuel Officer to resolve any differences (i.e., found in cell K42).

7. Charts Model

This model graphically represents the total JP5 fuel inventory ready for issue from the storage tanks and the total available storage tank space.
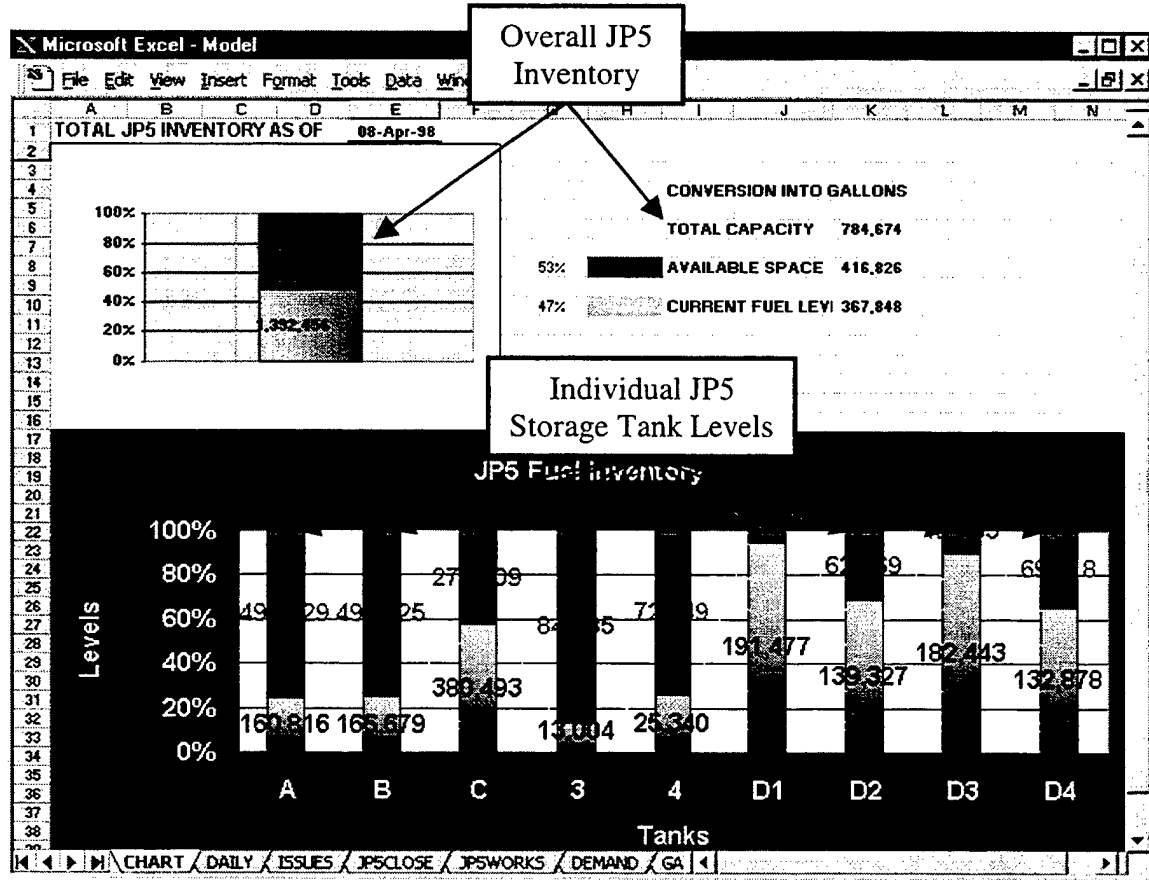
a) Create and Name the Seventh Worksheet

1. Choose Insert >> Worksheet.
   A new tab called "Sheet 7" will appear at the bottom of the viewing area.
2. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 7". The white cross will turn into a pointer.
3. Double-click. The text portion will darken.
4. Type in the word "CHARTS". ↵
5. Choose Edit >> Move or Copy Sheet >> Before sheet: DAILY >> OK.

b) Entering the Overall JP5 Inventory Bar Chart
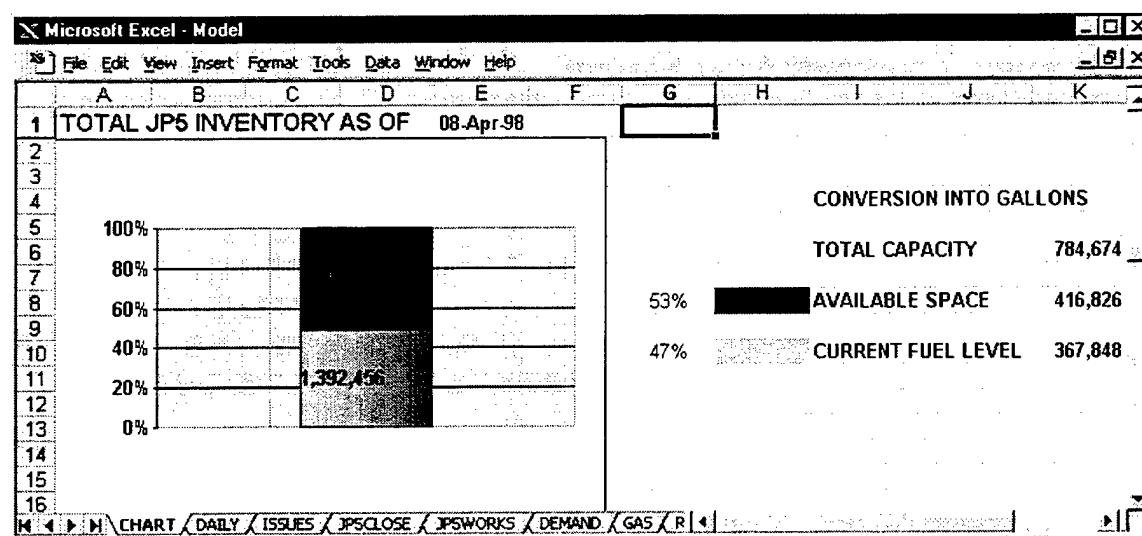
1. Select cell A1.
2. Type in the words "TOTAL JP5 INVENTORY AS OF". ↵
3. Select cell E1.
4. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell E1.
5. Click the Daily Model tab located to the right of the Chart Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

6. Select cell I1 (i.e., the shaded manual entry date cell).

Note: "=DAILY!I1" will be displayed in the formula bar.

7. Click on OK.
8. Select cell I4.
9. Type the words "CONVERSION INTO GALLONS". ↵
10. Select cell I6.
11. Type the words "TOTAL CAPACITY". ↵
12. Select cell I8.
13. Type the words "AVAILABLE SPACE". ↵
14. Select cell I10.
15. Type the words "CURRENT FUEL LEVEL". ↵

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	A	B	C	D	E	F	G	H	I	J	K
1	TOTAL JP5 INVENTORY AS OF				08-Apr-98						
2	A				652745						
3	B				659404						
4	C				655002			CONVERSION INTO GALLONS			
5	3				97589						
6	4				97989			TOTAL CAPACITY			
7	D1				201896						
8	D2				201896			AVAILABLE SPACE			
9	D3				201896						
10	D4				201896			CURRENT FUEL LEVEL			
11											
12											
13											

CHART / DAILY / ISSUES / JPSCLOSE / JPSWORKS / DEMAND / GAS

Tank Names

Tank Volumes
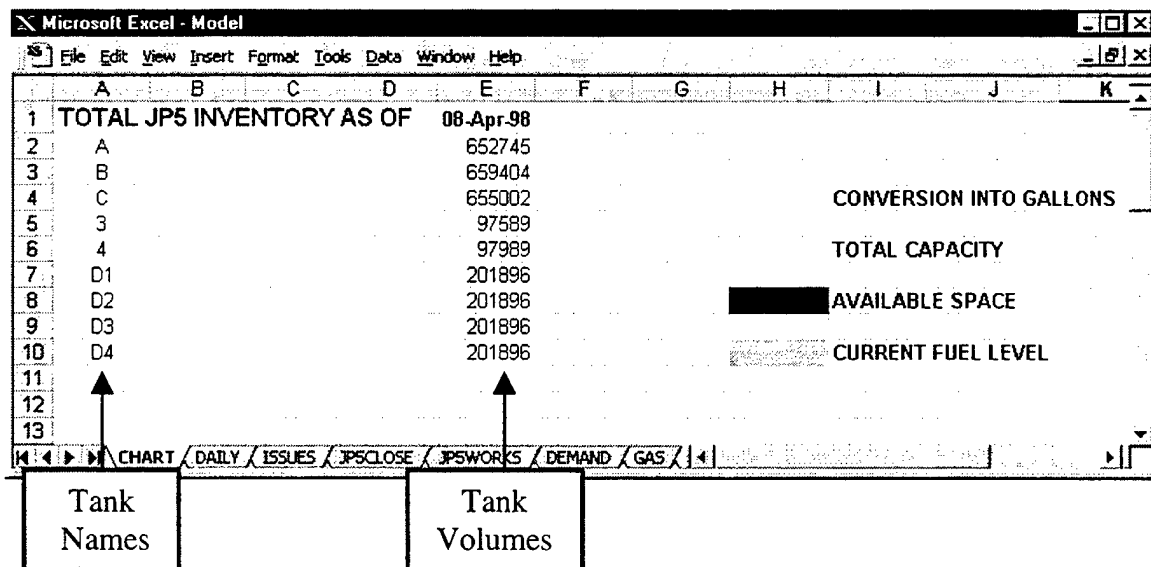
16. Select cell H8.
17. Choose
    Format >> Cells >> Pattern (tab) >> Select a color similar to maroon. >>
    OK.
18. Select cell H10.
19. Choose
    Format >> Cells >> Pattern (tab) >> Select a color similar to purple. >>
    OK.
20. Select cell A2.
21. Type in the name of the first tank (i.e., A). ↵
22. Select cell E2.
23. Type in the total volume capacity of the first tank (i.e., 652745). ↵

Note: Keep repeating the procedure of steps 20 through 23 for the remaining JP5
storage tanks. The names of the tanks must be in the same order as found
on the JP5 Close Model.

24. Select the next available cell in column E after the last tank volume entry (e.g.
    in the picture above it would be cell E11).
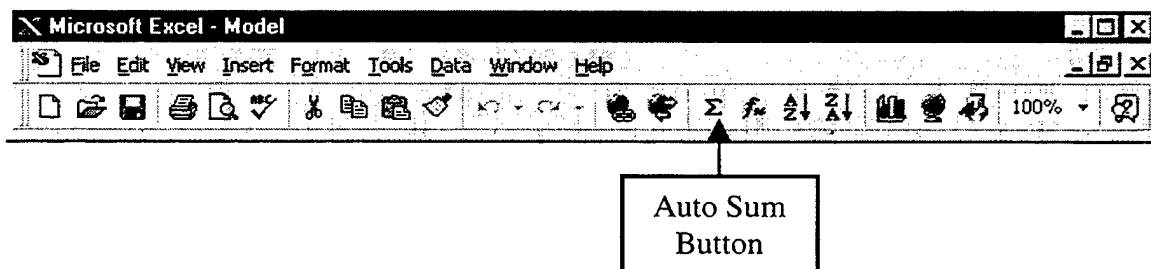
Auto Sum
Button

25. On the standard toolbar, click the Auto Sum button. ↵

Note: If the user's storage tank volumes are already in gallons, skip to step 30.

26. Select cell E12.
27. Type in the formula " =E11*0.264172 ". ↵
28. Select cell K6.
29. Type in the formula " =E12 ". ↵

Note: These steps convert the liters into gallons. Skip to step 32.

30. Select cell K6.
31. Type in the formula " =E11 ". ↵
32. Select cell B2.
33. On the formula bar, below the toolbars, click the " = " sign.
34. Click on the JP5 Close Model tab.
35. Select cell C7 (i.e., the total volume for the first tank).
36. Click on OK.
37. Select cell C2.
38. Type in the formula " =E2-B2 ". ↵
39. Highlight cells B2 and C2.
40. Drag the Auto Fill handle down the same number of rows, as there are tanks, and release.
41. Select the next available cell in column B (e.g. in the picture above, it would be cell B11).
42. On the standard toolbar, click the Auto Sum button. ↵
43. Select the next available cell in column C (e.g. in the picture above, it would be cell C11).
44. On the standard toolbar, click the Auto Sum button. ↵

Chart Wizard
Button

45. Highlight cells A11 through E20.
46. On the standard toolbar, click the Chart Wizard button.

47. Choose

   Custom Types (tab) >> Chart type: Stack of Colors >> Select from: Built-in >> Next >> Data Range (tab) >> Data range: Highlight the sum totals at the bottom of columns B and C (i.e., B11 and C11 in picture). >> Series in: Columns >> Next >> Axes (tab) >> Primary Axes >> Clear the "Category (X) axis" box. >> Automatic >> ✓ Value (Y) axis >> Gridlines (tab) >> Value (Y) axis: ✓ Major gridlines >> Legend (tab) >> Clear the "Show legend" box. >> Data Labels (tab) >> Data labels: Show value >> >> Data Tables (tab) >> Clear the "Show data table" box. >> Next >> Finished.

48. Place the cursor over the picture, the thick white cross will then turn into a pointer.

49. Drag the picture below the last occupied cells in columns A, B, C, D, E.

50. Select cell K10.

51. On the formula bar, below the toolbars, click the " = " sign.

52. Select the cell chosen in step 41 (i.e., sum total cell in column B).   ↵

53. Select cell K8.

54. Type in the formula " =K6-K10 ".   ↵

55. Select cell G8.

56. Type in the formula " = K8/K6 ".   ↵

57. Select cell G10.

58. Type in the formula " = K10/K6 ".   ↵

59. Place the cursor over the picture, the thick white cross will then turn into a pointer.

60. Drag the picture over the table created in columns A, B, C, D, E.

61. Click anywhere in column F to remove the highlighting of the picture.

62. Save work upon completion, ✄ ▉.

c) Entering the Individual JP5 Storage Tank Bar Chart

This chart will utilize the same data table that was developed in the last section (i.e., Entering the Overall JP5 Inventory Bar Chart).
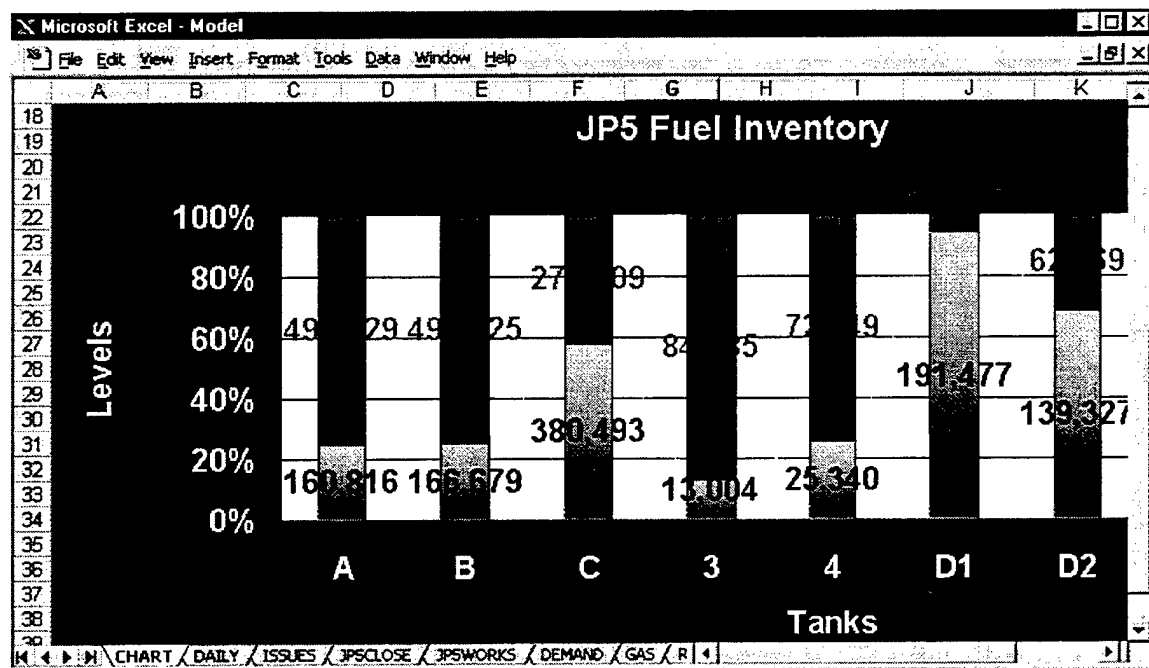
1. Place the cursor over the Overall JP5 Inventory Bar Chart, the thick white cross will then turn into a pointer.
2. Drag the picture over to the right enough to be able to see the table created in columns A, B, C, D, E.
3. Click anywhere in column A to remove the highlighting of the picture.
4. Select cell A18.
5. Highlight from cell A18 through cell M39.
6. On the standard toolbar, click the Chart Wizard button.

7. Choose
   Custom Types (tab) >> Chart type: Stack of Colors >> Select from: Built-in >> Next >> Data Range (tab) >> Data range: Highlight cells A2 though C10, <u>do not</u> include the sum totals at the bottom columns B and C (i.e., B11 and C11 in picture). >> Series in: Columns >> Next >> Titles (tab) >> Chart title: JP5 Fuel Inventory >> Category (X) axis: Tanks >> Axes (tab) >> Primary Axes >> ✓ the "Category (X) axis" box. >> Automatic >> ✓ Value (Y) axis >> Gridlines (tab) >> Value (Y) axis: ✓ Major gridlines >> Legend (tab) >> Clear the "Show legend" box. >> Data Labels (tab) >> Data labels: Show value >> >> Data Tables (tab) >> Clear the "Show data table" box. >> Next >> Finished.

8. Place the cursor over the picture, the thick white cross will then turn into a pointer.

9. Drag the picture below row 17.

10. Click anywhere outside the pictures border to remove the highlighting.

11. Place the cursor over the Overall JP5 Inventory Bar Chart, the thick white cross will then turn into a pointer.

12. Drag the picture over to the left enough to cover the table created in columns A, B, C, D, E.

13. Click anywhere in column F to remove the highlighting of the picture.

14. Save work upon completion, ✕ ▣.

Note: The Charts Model is complete.

d)   Using the Charts Model

This model is completely automatic (i.e., no manual entry required). It is recommended that the Fuel Officer review this model on a daily basis. These visuals provide the Fuel Officer with an accurate daily snapshot of their fuel inventory levels and available storage.

8. Demand Model

There are five distinct areas in this model. They are the External Input, Daily Demand, Monthly Demand, Annual Demand, and the Six Month Moving Average forecast. Special care should be taken when entering the lengthy formulas for this model.

```
Microsoft Excel - ModelCHARTS2                                    _ 8 X
File Edit View Insert Format Tools Data Window Help               _ 8 X
```

NAS SIGONELLA FUEL DEMAND

JP5

08-Apr-98

	mth	2		Demand	62,377	gallons			DAILY DEMAND FOR MONTH OF FEB	
	day	8					Day	Demand	Day	Demand
	yr	0					1	60023	16	
							2	47536	17	
		Monthly		Six Month Moving Avg.			3	39562	18	
		Demand		as of last day in JAN			4	54621	19	
1	JAN	1,400,231					5	56001	20	
2	FEB	1,319,130		1,142,214			6	59872	21	
3	MAR	1,623,802		1,262,822			7	32486	22	
4	APR						8	62377	23	
5	MAY						9		24	
6	JUN						10		25	
7	JUL	1,126,540					11		26	
8	AUG	1,201,635					12		27	
9	SEP	900,156					13		28	
10	OCT	875,995					14		29	
11	NOV	1,100,987					15			
12	DEC	1,256,785								

```
CHART / DAILY / ISSUES / JP5CLOSE / JP5WORKS \ DEMAND / GAS / Rece
Ready                                                          NUM
```

a) Create and Name the Eighth Worksheet

1. Choose Insert >> Worksheet.
   A new tab called "Sheet 8" will appear at the bottom of the viewing area.
2. Using the mouse, place the pointer on the lower left side of the worksheet marked "Sheet 8". The white cross will turn into a pointer.
3. Double-click. The text portion will darken.
4. Type in the word "DEMAND". ↵
5. Choose Edit >> Move or Copy Sheet >> Before sheet: RECEIPTS >> OK.

b) Entering the External Input Layout

This is the only area of the model that receives its input from sources outside the model.

1. Select cell A1.
2. Type in the name of the command plus the words "FUEL DEMAND". ↵
3. Choose Font Size Selection >> 14 ↵
4. Type in the name of the fuel (i.e., JP5). ↵
5. Choose Font Size Selection >> 14 ↵
6. Select cell C3.
7. On the formula bar, below the toolbars, click the " = " sign. This alerts Excel™ that the user is inserting a formula or linking data from another model to cell C3.
8. Click the Daily Model tab located to the left of the Issue Model tab.

Note: "=DAILY!" will be displayed in the formula bar.

9. Select cell I1 (i.e., the shaded manual entry date cell).

Note: "=DAILY!I1" will be displayed in the formula bar.

10. Click on OK.
11. Select cell B4.
12. Type the letters "mth". ↵
13. Select cell B5.
14. Type the word "day". ↵
15. Select cell B6.
16. Type the letters "yr". ↵

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17. Select cell C4.
18. Highlight cells C4 through C6.
19. Choose

  Format >> Cells >> Border (tab) >> Style: select a thin line. >> Outline >> Inside >> Patterns (tab) >> Cell Shading Color: select a light color (e.g. lt. blue). >> Pattern: select the color white. >> OK.

20. Select cell D4.
21. Type the word "Demand". ⏎
22. Select cell E4.
23. Choose

  Format >> Cells >> Border (tab) >> Style: select a thin line. >> Outline >> Inside >> Patterns (tab) >> Cell Shading Color: select a light color (e.g. yellow) that is different than the one used in step 19. >> Pattern: select the color white. >> OK.

24. On the formula bar, below the toolbars, click the " = " sign.
25. Click on the Issues Model tab.
26. Select cell C8 (i.e., the total issues for the day).
27. Click on OK.
28. Select cell F4.
29. Type the word "gallons". ⏎
30. Save work periodically and upon completion, ✄ ▪.

c) Entering the Daily Demand Layout

1. Select cell I4.
2. Type the words "DAILY DEMAND FOR MONTH OF". ↵
3. Select cell I4.
4. Choose   Font Size Selection >> 14 ↵
5. Select cell N4.
6. Type the formula " =VLOOKUP(C4,A10:B21,2,TRUE) ". ↵
7. Select cell H5.
8. Type the word "Day". ↵
9. Select cell I5.
10. Type the word "Demand". ↵
11. Select cell H6.
12. Type the number "1". ↵
13. Select cell H7.
14. Type the number "2". ↵
15. Highlight cells H6 and H7.
16. Drag the Auto Fill handle down column H and releasing at cell H20.

17. Click anywhere in column I to remove the highlighting of the area.
18. Select cell I6.
19. Highlight cells I6 through J20.
20. Choose

    Format >> Cells >> Border (tab) >> Style: select a thick line. >> Outline
    >> OK.
21. Select cell J6.
22. Highlight cells J6 through J20.
23. Choose

    Format >> Cells >> Cell Shading Color: select a light gray. >> Pattern:
    select the color white. >> OK.
24. Select cell L5.
25. Type the word "Day". ↵
26. Select cell M5.
27. Type the word "Demand". ↵
28. Select cell L6.
29. Type the number "16". ↵
30. Select cell L7.
31. Type the number "17". ↵
32. Highlight cells L6 and L7.
33. Drag the Auto Fill handle down column L and releasing at cell L18.
34. Click anywhere in column M to remove the highlighting of the area.
35. Select cell L19.
36. Type in the formula " =IF(C4=2,IF(C6=0,29,""),29) ". ↵
37. Select cell L20.
38. Type in the formula " =IF(C4=2,"",30) ". ↵
39. Select cell L21.
40. Type in the formula " =IF(C4=2,"",IF(C4=4,"",IF(C4=6,"",IF(C4=9,"",
    IF(C4=11,"",31))))) ". ↵
41. Select cell M6.
42. Highlight cells M6 through N21.
43. Choose

    Format >> Cells >> Border (tab) >> Style: select a thick line. >> Outline
    >> OK.
44. Select cell N6.
45. Highlight cells N6 through N21.
46. Choose

    Format >> Cells >> Cell Shading Color: select a light gray. >> Pattern:
    select the color white. >> OK.
47. Select cell J6.
48. Type in the formula " =IF(($C$5)=1,$E$4,"") ". ↵
49. Select cell J7.
50. Type in the formula " =IF(($C$5)=2,$E$4,"") ". ↵

51. Select cell J8.
52. Type in the formula " =IF(($C$5)=3,$E$4,"") ". ↵
53. Select cell J9.
54. Type in the formula " =IF(($C$5)=4,$E$4,"") ". ↵
55. Select cell J10.
56. Type in the formula " =IF(($C$5)=5,$E$4,"") ". ↵
57. Select cell J11.
58. Type in the formula " =IF(($C$5)=6,$E$4,"") ". ↵
59. Select cell J12.
60. Type in the formula " =IF(($C$5)=7,$E$4,"") ". ↵
61. Select cell J13.
62. Type in the formula " =IF(($C$5)=8,$E$4,"") ". ↵
63. Select cell J14.
64. Type in the formula " =IF(($C$5)=9,$E$4,"") ". ↵
65. Select cell J15.
66. Type in the formula " =IF(($C$5)=10,$E$4,"") ". ↵
67. Select cell J16.
68. Type in the formula " =IF(($C$5)=11,$E$4,"") ". ↵
69. Select cell J17.
70. Type in the formula " =IF(($C$5)=12,$E$4,"") ". ↵
71. Select cell J18.
72. Type in the formula " =IF(($C$5)=13,$E$4,"") ". ↵
73. Select cell J19.
74. Type in the formula " =IF(($C$5)=14,$E$4,"") ". ↵
75. Select cell J20.
76. Type in the formula " =IF(($C$5)=15,$E$4,"") ". ↵
77. Select cell N6.
78. Type in the formula " =IF(($C$5)=16,$E$4,"") ". ↵
79. Select cell N7.
80. Type in the formula " =IF(($C$5)=17,$E$4,"") ". ↵
81. Select cell N8.
82. Type in the formula " =IF(($C$5)=18,$E$4,"") ". ↵
83. Select cell N9.
84. Type in the formula " =IF(($C$5)=19,$E$4,"") ". ↵
85. Select cell N10.
86. Type in the formula " =IF(($C$5)=20,$E$4,"") ". ↵
87. Select cell N11.
88. Type in the formula " =IF(($C$5)=21,$E$4,"") ". ↵
89. Select cell N12.
90. Type in the formula " =IF(($C$5)=22,$E$4,"") ". ↵
91. Select cell N13.
92. Type in the formula " =IF(($C$5)=23,$E$4,"") ". ↵
93. Select cell N14.

94. Type in the formula " =IF(($C$5)=24,$E$4,"") ". ↵
95. Select cell N15.
96. Type in the formula " =IF(($C$5)=25,$E$4,"") ". ↵
97. Select cell N16.
98. Type in the formula " =IF(($C$5)=26,$E$4,"") ". ↵
99. Select cell N17.
100. Type in the formula " =IF(($C$5)=27,$E$4,"") ". ↵
101. Select cell N18.
102. Type in the formula " =IF(($C$5)=28,$E$4,"") ". ↵
103. Select cell N19.
104. Type in the formula " =IF(($C$5)=29,$E$4,"") ". ↵
105. Select cell N20.
106. Type in the formula " =IF(($C$5)=30,$E$4,"") ". ↵
107. Select cell N21.
108. Type in the formula " =IF(($C$5)=31,$E$4,"") ". ↵

d)   Entering the Monthly Demand Layout
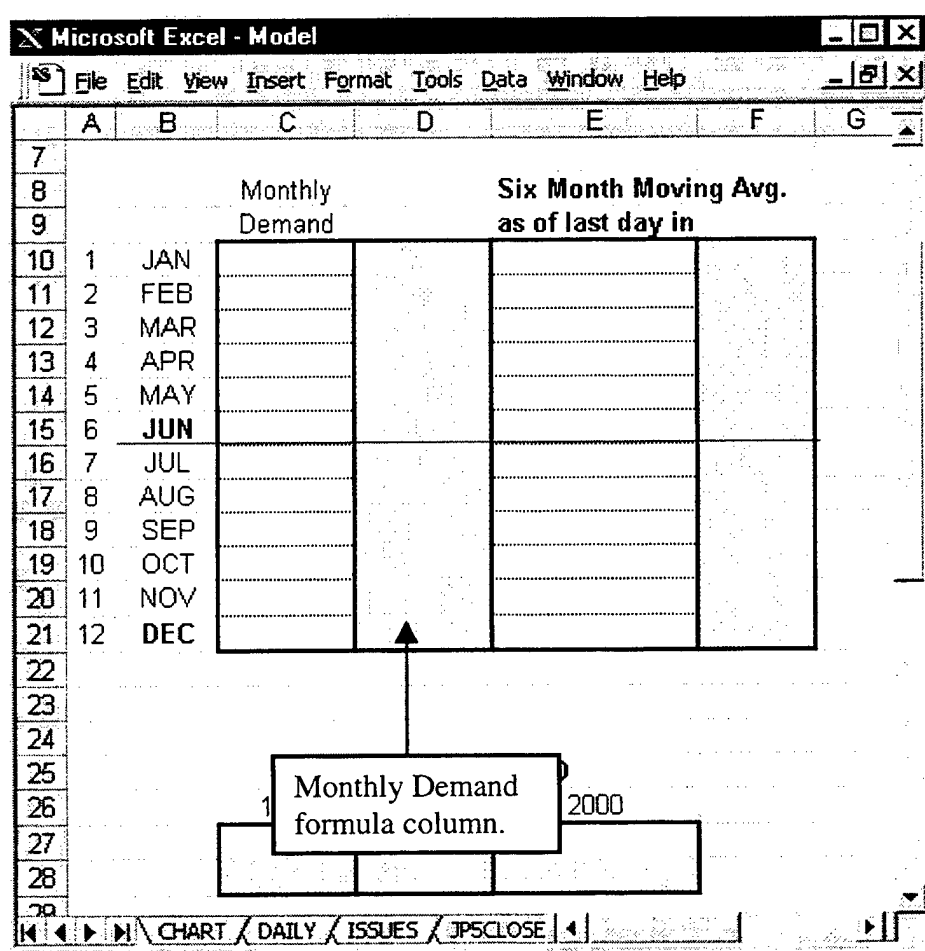
1. Select cell C8.
2. Type the word "Monthly". ↵
3. Select cell C9.
4. Type the word "Demand". ↵
5. Select cell A10.
6. Type the number "1". ↵
7. Select cell B10.
8. Type the number "1". ↵
9. Type in the letters "JAN". ↵
10. Select cell A11.
11. Type the number "2". ↵
12. Select cell B11.
13. Type in the letters "FEB". ↵
14. Highlight cells A10 through B11.
15. Drag the Auto Fill handle down column A and stopping at row 21. Release.
16. Select cell C10.
17. Highlight cells C10 through D21.
18. Choose
    Format >> Cells >> Border (tab) >> Style: select a thick line. >> Outline
    >> OK.
19. Select cell D10.
20. Highlight cells D10 through D21.
21. Choose
    Format >> Cells >> Cell Shading Color: select a light gray. >> Pattern:
    select the color white. >> OK.
22. Select cell D10.
23. Type in the following formula:
    =IF($C$4=1,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
24. Select cell D11.
25. Type in the following formula:
    =IF($C$4=2,IF((MOD(C6,4))=0,IF(C5=29,(SUM(I6:I20,M6:M19)),""),
    IF($C$5=28,(SUM(I6:I20,M6:M18)),"")),"") ↵
26. Select cell D12.
27. Type in the following formula:
    =IF($C$4=3,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
28. Select cell D13.
29. Type in the following formula:
    =IF($C$4=4,IF($C$5=30,(SUM(I6:I20,M6:M20)),""),"") ↵
30. Select cell D14.
31. Type in the following formula:
    =IF($C$4=5,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
32. Select cell D15.

33. Type in the following formula:
    =IF($C$4=6,IF($C$5=30,(SUM($I$6:$I$20,$M$6:$M$20)),""),"") ↵
34. Select cell D16.
35. Type in the following formula:
    =IF($C$4=7,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
36. Select cell D17.
37. Type in the following formula:
    =IF($C$4=8,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
38. Select cell D18.
39. Type in the following formula:
    =IF($C$4=9,IF($C$5=30,(SUM($I$6:$I$20,$M$6:$M$20)),""),"") ↵
40. Select cell D19.
41. Type in the following formula:
    =IF($C$4=10,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
42. Select cell D20.
43. Type in the following formula:
    =IF($C$4=11,IF($C$5=30,(SUM($I$6:$I$20,$M$6:$M$20)),""),"") ↵
44. Select cell D21.
45. Type in the following formula:
    =IF($C$4=12,IF($C$5=31,(SUM($I$6:$I$20,$M$6:$M$21)),""),"") ↵
46. Save work periodically and upon completion, ✄ ▣.

e) Entering the Six Month Moving Average Layout

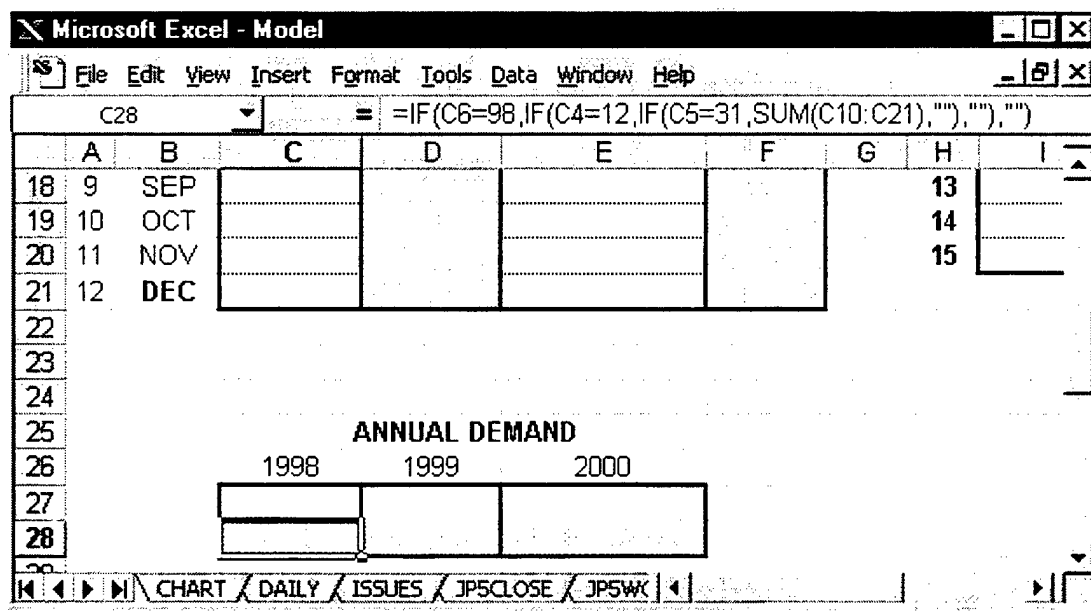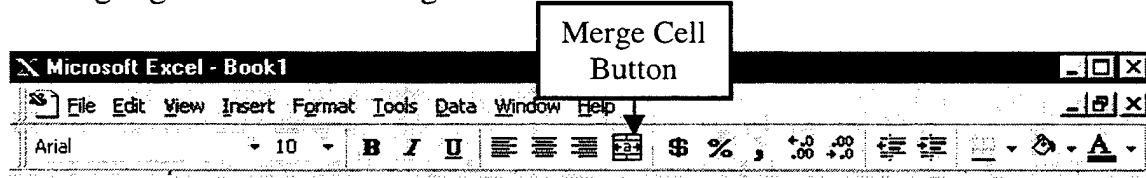1. Select cell E8.
2. Type the words "Six Month Moving Avg.". ↵
3. Select cell E9.
4. Type the words "as of last day in". ↵
5. Highlight cells E10 through F21.
6. Choose
   Format >> Cells >> Border (tab) >> Style: select a thick line. >> Outline
   >> OK.
7. Select cell F10.
8. Highlight cells F10 through F21.
9. Choose
   Format >> Cells >> Cell Shading Color: select a light gray. >> Pattern:
   select the color white. >> OK.
10. Select cell F9.

11. Type in the following formula:
    =IF((C4-1)=0,"DEC",VLOOKUP((C4-1),A10:B21,2,TRUE)) ↵
12. Select cell F10.
13. Type in the following formula:
    =IF($C$4=1,IF($C$5=31,(SUM(C17:C21)+C10)/6,""),"") ↵
14. Select cell F11.
15. Type in the following formula:
    =IF($C$4=2,IF((MOD(C6,4))=0,IF(C5=29,(SUM(C18:C21)+C10+C11)/6,"")
    ,IF($C$5=28,(SUM(C18:C21)+C10+C11)/6,"")),"") ↵
16. Select cell F12.
17. Type in the following formula:
    =IF($C$4=3,IF($C$5=31,(SUM(C19:C21)+C10+C11+C12)/6,""),"") ↵
18. Select cell F13.
19. Type in the following formula:
    =IF($C$4=4,IF($C$5=30,(SUM(C10:C13)+C20+C21)/6,""),"") ↵
20. Select cell F14.
21. Type in the following formula:
    =IF($C$4=5,IF($C$5=31,(SUM(C10:C14)+C21)/6,""),"") ↵
22. Select cell F15.
23. Type in the following formula:
    =IF($C$4=6,IF($C$5=30,(SUM(C10:C15))/6,""),"") ↵
24. Select cell F16.
25. Type in the following formula:
    =IF($C$4=7,IF($C$5=31,(SUM(C11:C16))/6,""),"") ↵
26. Select cell F17.
27. Type in the following formula:
    =IF($C$4=8,IF($C$5=31,(SUM(C12:C17))/6,""),"") ↵
28. Select cell F18.
29. Type in the following formula:
    =IF($C$4=9,IF($C$5=30,(SUM(C13:C18))/6,""),"") ↵
30. Select cell F19.
31. Type in the following formula:
    =IF($C$4=10,IF($C$5=31,(SUM(C14:C19))/6,""),"") ↵
32. Select cell F20.
33. Type in the following formula:
    =IF($C$4=11,IF($C$5=30,(SUM(C15:C20))/6,""),"") ↵
34. Select cell F21.
35. Type in the following formula:
    =IF($C$4=12,IF($C$5=31,(SUM(C16:C21))/6,""),"") ↵
36. Save work periodically and upon completion, ✕ ■.

f)   Entering the Annual Demand Layout


```
X Microsoft Excel - Model                                    _ □ X
    File  Edit  View  Insert  Format  Tools  Data  Window  Help      _ 日 X
         C28          ▼         =  =IF(C6=98,IF(C4=12,IF(C5=31,SUM(C10:C21),""),""),"")
      A    B       C        D         E         F     G    H      I
18    9   SEP                                              13
19   10   OCT                                              14
20   11   NOV                                              15
21   12   DEC
22
23
24
25                        ANNUAL DEMAND
26             1998       1999      2000
27
28
      CHART / DAILY / ISSUES / JP5CLOSE / JP5WK
```

1. Select cell C25.
2. Highlight cells C25 through E25.

Merge Cell
Button

```
X Microsoft Excel - Book1                                    _ □ X
    File  Edit  View  Insert  Format  Tools  Data  Window  Help      _ 日 X
  Arial          ▼  10  ▼  B  I  U   ≡ ≡ ≡ 国   $ % ,  .0 .00  律 律   ⬚ ▼ ◈ ▼ A ▼
```

3. Click on the Merge Cell button.
4. Type the words "ANNUAL DEMAND". ⏎
5. Select cell C26.
6. Type the year "1998". ⏎
7. Select cell D26.
8. Type the year "1999". ⏎
9. Select cell E26.
10. Type the year "2000". ⏎
11. Highlight cells C27 through E28.
12. Choose

> Format >> Cells >> Border (tab) >> Style: select a thick line. >> Outline
> >> OK.

13. Select cell C28.
14. Highlight cells C28 through E28.

15. Choose

    Format >> Cells >> Cell Shading Color: select a light gray. >> Pattern: select the color white. >> OK.
16. Select cell C28.
17. Type in the following formula:

    =IF(C6=1998,IF(C4=12,IF(C5=31,SUM(C10:C21),""),""),"") ↵
18. Select cell D28.
19. Type in the following formula:

    =IF(C6=1999,IF(C4=12,IF(C5=31,SUM(C10:C21),""),""),"") ↵
20. Select cell C28.
21. Type in the following formula:

    =IF(C6=2000,IF(C4=12,IF(C5=31,SUM(C10:C21),""),""),"") ↵
22. Save work periodically and upon completion, � ▣.

g)   Entering the Macro

The macro is the function that connects all of the other segments in this model together. The cells containing formulas were shaded gray and have an unshaded cell in the column to its immediate left. The macro for this section will be set up to perform the calculation in the gray cell (i.e., formula cell) and place the result in the unshaded cell. The macro is similar to a tape recording. It will only "play back" what was recorded. A well thought out plan is the key to a macro. If a mistake is made when "recording" the macro, delete the macro and start over.

1. Select cell F4.
2. Choose
    Tools >> Macro >> Record New Macro >> Macro name: Demand >>
    Shortcut key: Ctrl + z (**Note**: make sure caps lock is off.) >> Store macro
    in: This workbook >> OK

Note: As soon as the user hits OK, the recorder starts recording the moves.

3. Select cell J6.

4. "Right" click >> Copy.
5. Select cell I6.
6. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
7. Select cell J7.
8. "Right" click >> Copy.
9. Select cell I7.
10. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
11. Repeat steps 7 through 10 for cells J8/I8 through J20/I20.
12. Select cell I21.

Note: The user is moving to a new column.

13. Select cell N6.
14. "Right" click >> Copy.
15. Select cell M6.
16. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
17. Select cell N7.
18. "Right" click >> Copy.
19. Select cell M7.
20. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
21. Repeat steps 16 through 19 for cells N8/M8 through N21/M21.
22. Select cell M22.

Note: The user is moving to a new column.

23. Select cell D10.
24. Right" click >> Copy.
25. Select cell C10.
26. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
27. Select cell D11.
28. Right" click >> Copy.
29. Select cell C11.
30. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
31. Repeat steps 27 through 30 for cells D12/C12 through D21/C21.
32. Select cell C22.

Note: The user is moving to a new column.

33. Select cell F10.
34. Right" click >> Copy.
35. Select cell E10.
36. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
37. Select cell F11.

38. Right" click >> Copy.
39. Select cell E11.
40. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
41. Repeat steps 27 through 30 for cells F12/E12 through F21/E21.
42. Select cell E22.

Note: The user is moving to a new column.

43. Select cell C28.
44. Right" click >> Copy.
45. Select cell C27.
46. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
47. Select cell D28.
48. Right" click >> Copy.
49. Select cell D27.
50. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
51. Select cell E28.
52. Right" click >> Copy.
53. Select cell E27.
54. "Right" click >> Paste special >> Paste: Values >> Operation: Add >> OK.
55. Select cell F27.

Note: The user is moving to a new column.

56. Select cell D4.

Stop Recording Button
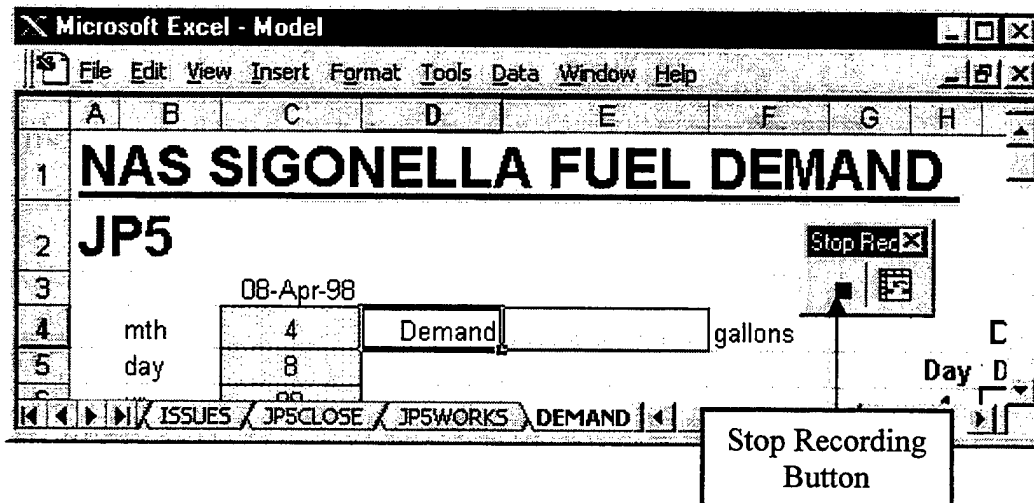
57. Press the stop recording button.
58. Save work upon completion, ✶ ▪.

h) Protecting the Demand Model

Protecting the model prevents accidental errors while viewing or working on the model. Certain cells will be "unlocked" to allow the user to make changes. The remainder of the sheet, namely the formulas, will be protected from change.

1. Select cell C4.
2. Highlight cells C4 through C6.
3. Choose
   Format >> Cells >> Protection (tab) >> Clear the "locked box" >> Clear the "hidden box" >> OK
4. Select cell I6.
5. Highlight cells I6 through I20.
6. Choose
   Edit >> Repeat
7. Select cell M6.
8. Highlight cells M6 through M21.
9. Choose
   Edit >> Repeat
10. Select cell C10.
11. Highlight cells C10 through C21.
12. Choose
    Edit >> Repeat
13. Select cell E10.
14. Highlight cells E10 through E21.
15. Choose
    Edit >> Repeat
16. Select cell C27.
17. Highlight cells C27 through E27.
18. Choose
    Edit >> Repeat
19. Save work upon completion, ✕ ▪.

i) Using the Demand Model

The Demand Model must be updated at <u>the end of the day after all issues have been recorded</u>. This model requires the user to manually enter the month, day and year. The year can be entered as two (i.e., 00) or four digits (i.e., 2000). After the date has been entered, the macro is utilized. Pressing the "Alt" key plus the "z" key will activate the macro. Disregard the numbers that appear in the gray shaded cells as they do not effect the final results.

All of the formulas in this model are "hidden" behind gray cell shading. These areas are then protected. Hiding and protecting the formulas helps to secure the user's accuracy in calculations and prevent accidental "cell clearing".

On the last day of the month, after the macro has been utilized, a copy of the model should be printed and retained. This provides a summary sheet of all the daily issues for that month. This area exclusively stores the daily information for the current month. After the printout has been made, all daily entries in rows "I" and "M" should be cleared. The next month starts a new list of daily demands.

On the last day of June, after the macro has been utilized, clear cells C16 through C21 and cells E16 through E21. If this area is not cleared, the macro will add new demand totals to old ones. Also, this procedure needs to be repeated for cells C10 through C15 and E10 through E15 on the last day of December, after the macro has been utilized.

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